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THE JOURNAL OF THE AMERICAN DENTAL ASSOCIATION

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Original Communications

SOME BASIC PRINCIPLES UNDERLYING PORCELAIN VENEER CROWN TECHNIC*

By WILLIAM D. VEHE, D.D.S., Minneapolis, Minn.

ALL restorative processes in the mouth are based on certain fundamental principles and requirements which have come to be accepted as sound practice. No restoration, no matter how masterly, can ever quite equal Nature's own efforts. For this reason, prevention is the noblest ideal we can have in mind and certainly should occupy first place in our efforts. It will never be reasonable to hope to eliminate the restorative problem entirely by methods of prevention alone, for assuming even that this could be done, there would still be the problem of accidents, deformities and other destructive processes to be coped with.

It seems without question that the teeth and mouth in health should be the norm in all estimation of a proper objective for a restoration. On this basis, any reconstruction, to fulfil one's highest conception, should fully restore and promote normal function, health and appearance, taking the place of the structure or structures it attempts to supply as nearly as possible. At the same time, careful consideration must likewise be given the conservation of tooth tissue together with the preservation of its health and usefulness, and a reasonable permanence of the restoration itself.

In considering porcelain as a medium for a restoration, it is found that it meets these requirements very admirably. Certainly it remains unequaled from the esthetic standpoint. It likewise promotes health and function of the affected parts, having certain slight advantages over other materials in this respect. Experience in its use has now been sufficiently long to afford a more accurate evaluation of its desirable as well as its undesirable qualities when used in the mouth, and

*Read before the Section on Partial Dentures at the Midwinter Clinic of the Chicago Dental Society, Jan. 14, 1930.

this knowledge should result in a superior and more matured judgment. Judgment is defined as "an operation of the mind involving comparison and discrimination by which knowledge of values and relation of things is mentally asserted or formulated," and so we are enabled, because of our observations of the behavior of porcelain in the mouth and our understanding of its qualities, to have a background for comparing and discriminating between the requirements of a restoration, on the one hand, and, on the other, the qualities of porcelain meeting these requirements. This knowledge helps us to formulate principles of practice which permit the fitting together, so to speak, of these values to best meet our purpose at this time.

Porcelain is selected quite exclusively for its esthetic qualities and rarely for its insulating and prophylactic properties. It has a decided disadvantage in its friability, and in order to take advantage of the desirable qualities, this many times embarrassing characteristic must at least be controlled within reasonable limits. There are several ways of doing this, of which the most important one concerns attention to bulk. The width of the shoulder, the condensation the porcelain receives and the proper fusing of it also contribute by giving it a better base and by insuring a denser and stronger mass. It has been shown by the United States Bureau of Standards that the strength of porcelain increases as the square of its thickness. This indicates clearly the importance of obtaining all the bulk or thickness that is possible for safety in this respect.

There are limits to which this can be carried, because of the anatomic makeup of the tooth to be restored, to insure its safety and comfort. No difficulty is experienced in this respect when the enamel only is removed. It is when more than this portion of a tooth crown is involved that the vital pulp may be endangered. Experience has shown us that a veneer crown that has a uniform thickness of about that of normal enamel has sufficient strength to withstand the average stresses applied to it. A study of tooth preparations accepted today as a foundation for this type of crown on the various teeth in the mouth demonstrates that this is the amount of tooth tissue which is removed except as we approach the cervical portion of the tooth, where usually a little more must be taken in the average case. Orton and Damon have shown that the dentin with the enamel removed does not exhibit a divergence of any of the axial walls incisally and occlusally, but rather that there is convergence of these walls. It is in the teeth that exhibit wear and in those which are malposed and rotated and which it is desired to place more closely in alinement that the possibility of pulp encroachment in making the preparation becomes a source of concern for future comfort and safety.

It is obviously important to place the shoulder under the free gum margin and to keep it there if possible. Gottlieb shows that this margin, which covers the area of a tooth that he chooses to call the cervico-enamel ridge, moves apically as age advances. This, of course, is not contrary to our clinical observations except that his histologic findings are somewhat different from what has been the accepted teaching. This statement clearly indicates that the shoulder should be placed farther under the free gum margin in young patients than in those of more mature years. Excessive recession of these tissues may come about through injury or neglect, while much may be done to preserve them

in health by proper prophylaxis and assurance of an accurate margin.

The width of the shoulder and its relationship to the surface are likewise factors in the strength and permanence of the crown. McCloskey shows, by a limited number of experiments, that a well-defined shoulder adds materially to the strength of the crown. Just what the shoulder width should be has not been determined except through clinical experience. It is known that bulk of porcelain gives it strength, on the one hand, and a generous shoulder is desirable from this standpoint. In contrast to this, the anatomic makeup of a tooth crown renders it necessary to limit the amount of tooth tissue that can be removed in order to insure its future safety. Experience further indicates that a shoulder 0.75 mm. in width, and in rare cases perhaps slightly more, can be made with safety on the larger teeth. A shoulder of this width permits of sufficient thickness in a crown to withstand the stresses that are ordinarily applied to it. In the smaller teeth, a shoulder of this width can hardly be obtained. Likewise, in hypersensitive teeth and in the teeth of younger patients, it may be more conservative to gage the width of this shoulder by the size and condition of the pulp; while in the teeth of older patients, this need not be a matter of concern.

The treatment of the margin of this shoulder deserves careful attention. The histology of the enamel in this region shows that it slants or deviates from 6 to 13 degrees centigrade from a line at right angles to the long axis. In other words, the enamel rods in the region of the shoulder are nearly at right angles to the surface and never at right angles to the long axis of the tooth. It is true that this shoulder has the protection of the subgingival tissues, but good operative procedures indicate the protection of the unsupported enamel rods, and therefore the short cut rods should be removed by planing the enamel portion of the shoulder so that it is placed at right angles to the surface. More than this should not be cut, as that would necessitate an attenuated porcelain margin, and as the strength of a porcelain margin and that of tooth enamel are so nearly identical, it is desirable that both of these be finished with their mutual protection in mind.

The contour of the dentin in any tooth crown very closely simulates the original form except as the cervical portion is approached, where the enamel is found to become progressively thinner until the gingival line is reached. As was pointed out before, no undercuts or constrictions are normally found near the cervix after the enamel has been removed. It is in this region that usually more than the normal layer of the enamel is removed in preparing the shoulder, and this necessitates the shaping of all axial walls so that there are distinctly no undercuts, but, on the contrary, they are very slightly converging so that an impression may be removed without distortion. It is important in this connection not to have walls too greatly converging either, particularly on the proximal surfaces, for greater safety to the pulp and better retentive resistance.

The construction of any porcelain restoration, and particularly the veneer crown, necessitates the consideration of a number of basic principles in order to incorporate the fullest possibilities into it. Strength is the primary consideration on the presumption that, if all the other desirable features were built in, they would be of no avail, if the work failed through fracture. Our study of the prep-

aration of the tooth has revealed to us the desirability of taking advantage of all possible bulk and also of the employment of a reasonable and well-defined shoulder together with quite parallel walls and plane surfaces on the incisal and occlusal surfaces. Such a preparation permits of the greatest possible respect for the dental pulp and a uniformly even and sufficiently thick bulk of porcelain throughout the restoration, thereby laying what seems to be the best foundation for this material.

In the construction of a restoration, it remains for one to incorporate the features that will contribute to the greatest possible service in every way, and this implies the working of the porcelain, both in laying it down and in fusing it, to gain the maximum density and to obtain the correct colors properly distributed. It further demands the building in of correct individual tooth forms for both the psychologic and physiologic requirements, i. e., not only to enhance the esthetic feature, but also to promote the best possible function in every way.

The strength of porcelain, while it is dependent on bulk of material primarily, likewise also demands a maximum condensation of the mass. Gill has shown the results of building porcelain in various ways by a study of it under the microscope, by density tests, and by observation of its behavior during the fusing process. He points out, with the aid of the microscope, that a well-condensed porcelain has fewer and smaller air spaces in it, while porcelain that is not so well condensed may show an irregular pattern of small and large air spaces or a more regular pattern of numerous small air spaces throughout the entire mass. His density tests show definitely the greater compactness of well-condensed porcelain. The problem in this respect, then, is to obtain a maximum condensation of the mass and the elimination of the air spaces, and how this is done does not make any difference provided it is accomplished.

The strength of porcelain can be further controlled during the fusing process. The relative strength of porcelain that is underfused, correctly fused and overfused has not been shown; at least, no report has come to my attention. It would be helpful and interesting to know how much damage is done to porcelain by improper fusing. McCloskey shows, in comparative tests, that the skill with which porcelain is handled in the baking governs the strength to a large degree, and he states that "poorly baked porcelain on a tooth with a good shoulder is only as strong as a well baked porcelain on a tooth without a shoulder." He does not enlarge on what skill is necessary to fuse porcelain properly, nor what its treatment should be from the point where it has been fused and the maximum temperature has been reached.

There seems to be no definite information about what can happen to porcelain in the cooling process. This procedure possibly does not contribute much to its strength except as far as its tenacity or brittleness would make a difference. Manufacturers of porcelain objects and also of porcelain teeth insist on cooling their products very slowly for the purpose of annealing them, and thereby develop a tenacity which is important to their strength. In dentistry, we follow such a procedure more or less empirically.

A series of unofficial tests made of the strength of porcelains that were fused and cooled in different ways did not reveal much difference in their physical behavior. On the other hand, when the ingredients in a body were changed,

strength tests immediately indicated this. While these tests were not intended to be conclusive, it is evident that much work is yet to be done in ceramics and with the various ingredients which it involves. The chemistry of porcelain is being studied more extensively at this time, and it is hoped that this knowledge may be available and helpful toward putting porcelain work on a more rational basis.

Experience shows that porcelain should not be fused any more often than is necessary and that the temperature should be kept at a minimum during biscuiting. In this connection, Gill clearly shows that the maximum amount of contraction in porcelain takes place at a lower temperature when it is well condensed, and his findings further emphasize the importance of creating a dense mass while building the body.

The building in of correct individual contour is a most important part of the work. When the colors are laid down during the building operations, the correct individual contour or form the crown is to assume necessarily must be kept in mind for the purpose of distributing the colors correctly when the contour is worked out. This phase of it has already been touched on in discussing the esthetic requirements. It is desired to further observe it, at least in a general way, from the physiologic standpoint, and the minimum requirements from this aspect are for the promotion of health and function.

The health of the investing tissues of a tooth requires that the contour of the crown portion be such that, in the incising and mastication of food, it will be deflected over these tissues without injury to them. The contour of the anterior upper teeth indicates how this is done by the decided convexity on their labial surfaces, which assures conduction of the food past the sensitive gingival tissues. On the lingual surfaces, this is accomplished by the cingulum and marginal ridges around the lingual fossa.

In reconstructing these teeth, the mistake is often made of not building in these important features. Often, the labial surface is left too flat. The principal mistakes usually seem to be made on the lingual surface, when it is made more or less flat or even convex, without any fossa or marginal bands. In some instances, this potential error arises during the preparation of the tooth through not removing enough tooth structure on this surface to allow for its accurate reproduction. At other times, there is unquestionably a lack of appreciation of this need or of its importance. Such a surface is not the most efficient one to incise against even aside from its pathologic tendency.

The lower anterior teeth, on the other hand, have no marginal ridges, nor have they a lingual fossa on the lingual surfaces even though they simulate the upper anterior teeth in other respects. The direction of the forces in this region and the manner of incising clearly show the lack of need for them.

Nature has provided similar means for protecting the gingivae in the posterior teeth. In the first place, we observe the contour of the buccal and lingual surfaces of the upper bicuspids and molars to be convex, particularly toward the cervical half of the crown. The direction of these curved surfaces starts the food over the crest of the gingivae sufficiently not to harm them. This convexity simulates a bulge on the buccal surfaces of the lower bicuspids generally, and while not always quite so prominent in the molars, it is sufficient to protect these tissues. The lingual surfaces of these teeth protect the

soft tissues not alone by the slight thickening of the enamel but also by the direction of the occlusal planes in relation to these surfaces, as in the bicuspids, particularly the first bicuspids, and by the location of the lingual cusps well to the lingual margin of the tooth in the molars.

The proximal gingival tissues are protected by a proper contact between adjoining teeth and by the marginal ridges. The contact point is most nearly perfect in youth; and as age advances, it is found to be closer to the occlusal surfaces. At the same time, it becomes broader and flatter, but as long as there is no pathologic condition present, it must be considered physiologic. A close observance of the normal contact point will show that it is located rather near the occlusal surfaces in the posterior teeth, and, broadly speaking, nearer the buccal surfaces in line with the points of the buccal cusps. In the anterior teeth, this point is placed about the center of the incisal third of the tooth and in line with the cutting edges.

Possibly no part of a tooth surface is more abused in our reconstructional procedures than the placing of these contact points. The greatest importance must be attached to the form of the contact between teeth in that it must be a point and not a surface; in other words, it must not retain fibers of food, but force them through at once. Then, also, the interproximal spaces must be sufficiently large to allow for healthy tissues.

Another abuse that is often observed is in the location of the marginal ridges in the posterior teeth, as in so many instances these ridges are placed too high on the occlusal surfaces. When this is done, the opposing cusp is prevented from having a free and liberal excursion area, and, at the same time, any wear that necessarily takes place, or any grinding that must be done for their adjustment, tends only to flatten them and cause the formation of a sharp margin toward the contact point. These ridges act like the rim of a bowl to prevent the food from injuring the interproximal tissues, and great care should be exercised in building them in any area of the mouth.

The occluding surfaces must be built for the all-important function of effectively grinding food. A study of the unworn occlusal surfaces of the posterior teeth reveals the fact that these elevations of enamel, the cusps, are not smooth pyramids but are traversed by an intricate formation of minor ridges and furrows which lead from the summits of the cusps toward the center of the tooth into the main grooves. These formations are placed here by Nature for greater masticating efficiency, and it is well known that when these are worn away and larger plane surfaces are consequently formed, greater force is required against these surfaces in the process of mastication. In our restorations, when such a condition exists and must necessarily be reproduced, the margins should not be rounded off but should be left sharp to increase their usefulness in function. The porcelain on the occluding surfaces should generally not remain highly glossed but should be ground and then quite thoroughly polished. Such a surface is more efficient for mastication.

The treatment of the cervico-enamel surface is mentioned last with the hope of lending it additional emphasis. This is a most important area, and it is only with the greatest attention to details that it will remain in a healthy condition and that there will not be more than normal recession. As a prophylactic measure, no deposits should ever be allowed to remain on the tooth structure in this area. Obviously, the crown should accurately fit

down on the shoulder, and the margins between these structures should be as smooth as possible. The porcelain should be fully fused, and this glazed surface must not be ground or disturbed after that. Lastly, the crown should be normally contoured here so that there will be a natural tension on these tissues.

Esthetics is certainly a fundamental quality in the veneer crown since it is the basis for its selection in the first place. Esthetics is the science of the beautiful in nature and art, or, as it is also stated, the philosophy of the beautiful. A thing is beautiful when it excites pleasure in the higher faculties of sense perception. Continuing our trend of thought, in analyzing the qualities that do excite pleasure or displeasure when a finished crown is viewed in the mouth, we find that there are several, such as color, form, position and also texture.

Naturally, the quality that most violates our sense of the beautiful is the first to be observed, and quite generally that is color. Any deviation from the colors in the normal teeth in the mouth is observed not alone in the color of the dentin but also in that of the enamel, and, lastly, in the blending of the one color with the other.

Form is next in importance to color, and at once we are either pleased or offended in proportion to the closeness with which the work simulates the natural form in the mouth. It seems to be a well-recognized experience that form alone or color alone is not the whole problem in producing a natural and lifelike restoration, since, in very many mouths, particularly in those of advanced age, the color of the teeth varies in like teeth in opposite sides of the arches, which in certain limits is not displeasing. A restoration in such cases would permit a certain narrow latitude in the interpretation of color, but this latitude would certainly be still more narrowed if the form were not correct. In like manner, when color interpretation is correct, and form simulation not so accurate, it will be observed that the restoration suffers to that extent.

Position of the restoration has something to do with the esthetic result also, although we do not offend so much in this respect.

The problem before the dental ceramist who desires to produce a harmonious and lifelike restoration in the mouth may be spoken of as requiring a careful observance, first of all, of what he wishes to reproduce, and, secondly, as to how he proposes to accomplish it with his porcelains. This problem of carefully observing what he wishes to reproduce is a subtle and an extremely important one, for on this primarily hinges the entire esthetic result. From the standpoint of color, there is no question that the ceramist must see it correctly and be able to recognize the minute differences in the hues as he wishes to deal with them. The first requisite for this is a proper light condition. Perfect white light of the proper intensity is necessary. Sunlight, so far, is our most perfect source of light, because it contains all the color rays in even distribution. It is composed of ether waves that have a frequency of between about twenty-three trillion and 1,500 trillion cycles. The human eye is altogether incapable of perceiving more than a small part of this entire scale of frequencies, for it cannot begin to detect the infrared rays until they reach a frequency of about 375 trillion cycles, and it ceases to recognize the ultraviolet rays after they reach a frequency of somewhere around 1,000 trillion cycles.

When it is kept in mind that objects are visible only because of the light that

they reflect, it becomes obvious that the visibility of a nonluminous object is entirely from the amount and kind of light that is not absorbed but is either transmitted, reflected or refracted to us. An object that reflects light equally is thought of as being white, while objects that do not have this property show colors. There is no known object which either absorbs or reflects all the light that reaches it, and, in this connection, it must be apparent that the character of this reflection must be in direct ratio to the amount and kind of light which reaches it. It is difficult to explain the complexities of the action of nonluminous bodies on light. Observation shows one that there are hardly two objects which appear alike. A surface that is polished has entirely different characteristics from one that is roughened, and the degree of roughness likewise makes a difference. A surface may be plane or wavy, and the opacity or transparency of an object each has its own influence. This is not the whole color problem, but the vagaries of the human eye are such that these tendencies should be recognized and guarded against.

The psychology of color or the reaction of the human eye to colors is always most interesting. The action of the retina seems to be to neutralize whatever color is viewed by the addition of its complement. This is plainly evident in many ways. When viewing two colors that are placed side by side and which are complementary, it will be observed that each is more brilliant along the line of contact. This is more plainly shown when viewing a single color and then focusing the eye on a neutral field, which will show a successive contrast in the form of an afterimage that always is the complement of the color viewed. Again, in looking at this original color, if instead of focusing the eye on some neutral field, we focus it on a colored field, we observe a mixed contrast in that this afterimage is superimposed on the colored field and a mixture of the two colors results. These afterimages are brought about by fatigue of the retina in viewing a color, and they become strengthened as the color inspection is prolonged to the point where this reaction results in the graying of the color that we look at. The explanation for this is that when a color is mixed with its complement, a gray or black is always formed.

One must observe that color is an invariable phenomenon fundamentally in that its reactions and manifestations are definite under like conditions. It must be evident at once that our source of light is very important; for not only does the intensity or the lack of it particularly make it harder for us to see colors correctly, but also the kind of light, whether it is white or has a predominance of some color rays, lends itself to a correct color determination. For instance, it is observed that the difference in the yellow and orange hues cannot be so readily differentiated in direct sunlight. As these hues are the fundamental colors in the human teeth, it follows that direct sunlight is not the best light to view them in. Again, reflections of colors in a room or from some outside source, as from buildings, roofs, walls or even green trees, may cause one much trouble because of their contamination of the light source.

The effect that the object, in our case the teeth and surrounding structures, has on the light rays is likewise important to us. This is particularly true from the standpoint of its physical makeup, i. e., its quality of color reflection or surface texture, whether it has a polished surface or a rough surface, or whether it is plane or wavy, and the character of these in-

equalities, and also its opacity, or, shall we say, translucency.

Now as regards what we actually perceive, it must be borne in mind that about 5 per cent of the population is color blind to some degree. Those who are thus affected cannot expect to get the usual reaction from colors. The normal eye is capable of all the psychologic reactions that have already been mentioned, and in determining color in the mouth, these reactions must be guarded against. It is probably true that the average dentist observes the color of the cervical portion of a tooth first and of the incisal or occlusal portion last. The former is some hue of orange, and, as such, it is possible that it may be influenced by the decided redness of the lips or gum tissues, particularly if this tooth color is a tint bordering on whiteness. Since the tendency of the retina is to neutralize color by the addition of its complement, it is reasonable to expect the complementary color of the lips or tissues, which is green, to modify or even change the cervical color so that it may be perceived as being lighter or even as having a bit of green in it. This is more noticeably true if we have had to spend much time in this determination. The apparent hue of the incisal or occlusal portion is likewise apt to be influenced in the same way.

After the ceramist sees the colors in the tooth correctly, he proceeds to select porcelain colors with which he proposes to interpret them. Since no dentist is sufficiently acquainted with porcelain colors to choose them consistently without the aid of what is known as a color guide, and there seems to be no reason why he should either, these samples should accurately represent the colors he has to work with. The use of a tooth color guide or a manufacturer's guide is certainly not in order unless it has been tested for accuracy. Better still, samples of porcelains as they are used in the laboratory and fused in suitable forms cannot be improved on as a guide. With the aid of these, it is the ceramist's task to determine just what colors he proposes to use and how he is going to apply them to meet the color requirements of his restoration. At this time, he also observes how he desires to fuse his porcelain to best obtain the texture requirements of the case.

The form requirement can be worked out in a similar way. Since the restoration is generally built up indirectly with the help of casts, these should include the teeth that represent the individual form, and they should be sufficiently accurate to show the fine details of the case. Even with such casts before one, limitations are quickly observed when the tooth is fitted in the mouth, as it should be before it is finally completed.

Teeth are hardly ever completely smooth on the labial or buccal surfaces. Characteristic markings such as imbrication lines, developmental grooves, or the lack of them, and individual irregularities in markings should be carefully observed. The labial and buccal convexity is of great importance, as likewise is the individual contour of the line angles. In the anterior teeth, the incisal third of the tooth is an important area esthetically, and this must include the thickness of this portion together with the condition of the incisal margin and the angles. The lingual and proximal contour must be observed just as carefully. On the occlusal surfaces, the condition of the pits and grooves, the contour of the cusps and the degree of wear present mean much and not alone from the esthetic standpoint.

The whole esthetic problem revolves around the thought of harmony between

the restoration and the individual mouth. Any restoration is artistic in proportion to its ability to conceal itself.

These fundamental principles are the high spots, so to speak, of the groundwork on which successful porcelain restorations must be built. Experience has emphasized these as some of the more important points that must come up in operative procedures. Facts are the inviolable things that confront us on every side, and since we must live with them, it is but sound logic that we strive to understand and heed them.

THE STEREOROENTGENOGRAM AS AN AID IN DIAGNOSIS*

By LELAND RAY JOHNSON, D.D.S., M.S.D., Chicago, Ill.

THE dental literature on the subject of stereoscopic roentgenography is limited to a few articles, the majority of which deal with the technic of making stereoscopic roentgenograms. Some of these present a good, concise technic, while others present a technic which is neither helpful nor concise. There are very few which deal with the advantages or the possibilities of the stereoroentgenogram other than to mention them.

Edmund C. Kells[1] produced the first dental stereoroentgenogram in 1903, and, at that time, laid this new art in dentistry before the members of the National Dental Association. The profession was slow to take it up, and nothing on this subject again appeared until another article by Dr. Kells was published, in 1912. In this article, he again tried to stimulate the interest of the profession in stereoscopic roentgenography, and described the technic of making stereograms. Since then, only a few articles have appeared.

In 1924, Clarence O. Simpson[2] presented a good, concise technic for making stereoroentgenograms, but he omitted the method of placing the films in the mouth, an exceedingly important phase of this work.

An exceptional article by C. A. LeMaster,[3] describing the making and mounting of stereoroentgenograms, appeared in 1924. In this article, he presented a good, practical technic for both intra-oral and extra-oral stereoroentgenograms. The technic for mounting is very clearly described, and his technic for producing stereoroentgenograms has been followed in a general way in this study.

Very little mention is made in regard to the practical value of the stereoroentgenogram to the orthodontist. LeMaster says:

*Read before the Section on Orthodontia at the Midwinter Clinic of the Chicago Dental Society, January 14, 1930.

1. Kells, E. C.: Stereoscopic Dental Skiagraphs, Dent. Cosmos, 54:745-757 (July) 1912.

2. Simpson, C. O.: Technic of Oral Radiography-Stereoscopic Examination, Internat. J. Orthodon., 10:437-441 (July) 1924.

3. LeMaster, C. A.: Dental Stereoroentgenography, Dent. Cosmos, 66:642-648 (June) 1924.

The practice of orthodontia is a most scientific and exacting branch of the dental profession, and the orthodontist who really obtains results is the one who carefully diagnoses his case and plans his treatment. This is at times very difficult to do, as many unforeseen things may come up during the treatment which are very discouraging, whereas if he had had a clear understanding of not only the relation of the erupted teeth, but also the unerupted ones, with reference to their lines of eruption, their position in the process with relation to the surrounding teeth

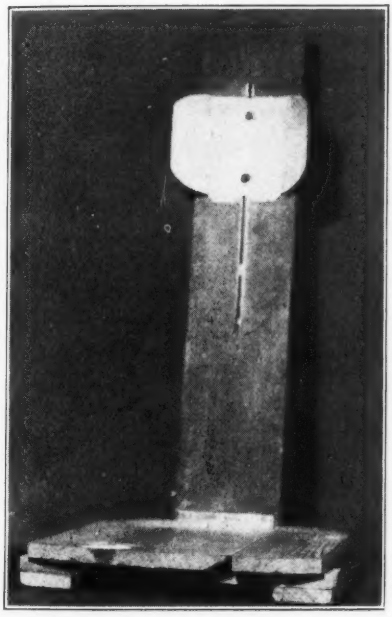

Fig. 1.—Seat with hinged back and sliding tray.

and structures, he would have been able to avoid many of these conditions. It is easy to determine these conditions if one will study a stereoroentgenogram, for they surely afford an ideal study model for orthodontia cases.

This is indeed a general statement, and yet the most detailed one that I have been able to find in the dental literature. Naturally, the question arises: Of what value is the stereoroentgenogram in the practice of orthodontia?

The object of this investigation was to determine the real value of the stereoroentgenogram in the diagnosis and treatment of orthodontic cases. Two general questions present themselves: 1. Does the stereoroentgenogram show the bone structure and teeth in their real relations and in their respective planes? 2. Is it possible to demonstrate, by means of the stereoroentgenogram, the normal physiologic change in the bone structure

Fig. 2.—Individual plaster headrest.

which is the result of pressure stimuli applied to the crowns of the teeth?

Dry bone specimens were used in several experiments to determine the relation of the buccal or labial and the lingual plates of bone as a definite guide in the interpretation of the stereoroentgenogram of living patients. Dry specimens were also used in experiments to determine whether the stereoroentgenogram reveals the true position and inclination of the roots of the teeth.

Eleven cases, showing unerupted, supernumerary and impacted teeth, and a few with unusual characteristics, were chosen from the Northwestern University Dental School clinic for a study of the location of the involved structures. Seven cases under orthodontic treatment in this clinic were employed in a comparative study to determine whether or not a normal physiologic change in the investing tissues of the teeth, the result of pressure stimuli applied to their crowns, can be demonstrated in the stereoroentgenogram.

The demonstration of bone change

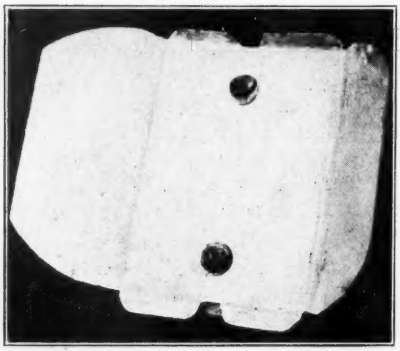

Fig. 3.—Sliding tray.

necessarily calls for a comparison of stereoroentgenograms before orthodontic treatment, and after such treatment has progressed until there has been a rearrangement of the bone lamellae. To make an accurate comparison, it is desirable that all factors except the change in the tissue remain constant.

To place the patient in the same position at two different sittings, a seat with a hinged back carrying a sliding tray is used. (Fig. 1.) The seat is made to fit in one position in a dental chair with the cushion removed. The back rests against the back of the chair, and an individual headrest of plaster (Fig. 2) is carried by the tray. This tray can be set according to a scale attached to the opposite side of the back. (Fig. 4.)

Before the orthodontic appliance is placed, the patient is seated in this chair, and the tray is placed so that a plaster impression of the back of the neck, and the back and top of the head, can be

Fig. 4.—View of seat showing recording scale.

made. The patient's head is covered with a rubber cap and placed in the desired position, and the impression is taken. The reading on the scale is then made and noted.

The position of the chair and the x-ray machine must be the same in every case. This is established by dropping two plumb lines from two fixed points on the

overhead arm of the x-ray machine to two fixed points on the chair. The patient is then placed in the chair and the head properly placed in the plaster headrest, where it is tied so that there will be no movement. The tube is adjusted, and all movable parts locked. The readings of the tube and all movable parts are then observed. (Fig. 5.)

The control picture is made, and after a period of time, in which a physiologic movement of the teeth has started, the

Fig. 5.—Patient prepared for making a comparative stereoroentgenogram.

patient is again placed in the chair and another stereoroentgenogram is made, the same readings as before being employed. In this way, a stereoroentgenogram is produced for comparison with the control stereogram.

This is a more or less crude method and far from practical, but to date no better method has been devised to my knowledge. Owing to the mobility of the soft tissues covering the bone, the location of definite anatomic points separated widely enough to allow for no movement of the head in any direction presents a difficult problem.

In producing two stereoroentgenograms as nearly alike as possible, it is necessary to use the same time of exposure and the same milliamperage. A trial exposure should be made to check up the milliamperage before exposing the film. The milliamperage is difficult to control because of the line fluctuation. The difficulty arising when milliamperage cannot be controlled may be overcome to a certain extent by developing the picture a half-minute more for every milliampere of fluctuation below that of the first picture, or a half-minute less per milliampere of fluctuation in the opposite direction.

The second stereoroentgenogram must be left in the developer the same length of time as the one with which it is to be compared. The temperature of the developer must also be the same in both instances. If the temperature of the developer should be a degree or two below 65 F., the film should be allowed to remain in the developer about one-half minute more. The age of the developer should also be taken into consideration, and all pictures to be compared should be developed in the same aged developer.

In every film packet there are two films, and the upper film of both the left and the right exposed packets should be placed on the same developing rack. This eliminates chance for error in developing each pair exactly the same. These steps are very important and must be observed to obtain an accurate comparative picture.

To be sure that there was no error in the technic in attempting to make two

stereoroentgenograms exactly alike at two separate sittings, a check of the technic was made.

Of the stereoroentgenograms made for comparison, those that checked were considered as being free from any variation introduced by error in the technic, and that it is more satisfactory to view stereoroentgenograms from the glazed side of the films instead of the emulsion side. This method of viewing gives us the "lingual aspect," and we are inside the mouth looking out. Viewing a stereoroentgenogram from the lingual aspect brings up

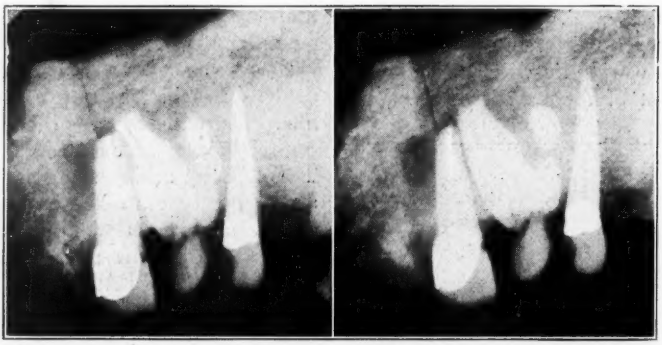

Fig. 6.—Prepared specimen showing the teeth in their respective planes.

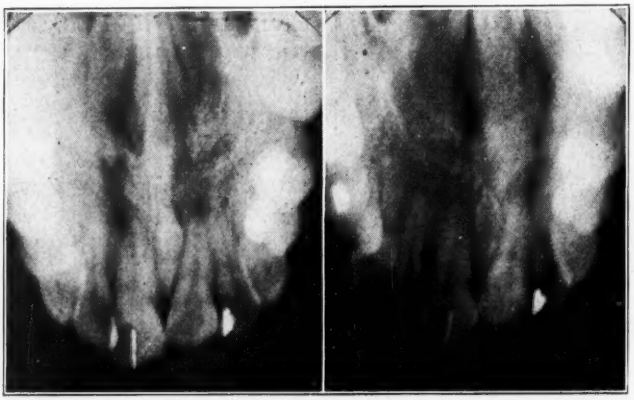

Fig. 7.—A supernumerary tooth.

suitable for demonstration of the change in the structures resulting from tooth movement.

It is generally agreed among writers on the subject of stereoroentgenography the question as to how much of the bone is really the lingual plate.

To determine this, a stereoroentgenogram was made of a mandible, the labial plate of bone was cut away gingivally as

far as the apex of the cuspid and first bicuspid, and the lingual plate was removed opposite the lateral and central teeth to their apices. Another stereoroentgenogram was then made and compared with the first.

The first stereogram showed bone on the lingual aspect, especially toward the root apex. Toward the crest of the alveolar process, it became fainter, as it was much more easily penetrated because of its decrease in thickness.

The second stereogram, made after the bone had been removed as indicated, revealed a great difference between the cut and retained portions on the lingual aspect. Lingually from the cuspid and bicuspid, where the labial plate of bone had been removed, the bone appeared as in the first picture, but not quite so dense. A shadow was observed where the bone had been removed, but the structure, in general, was the same on the lingual aspect as it was before the bone was removed. Where the lingual plate was removed the labial plate showed as a thin layer, but did not show so much bone structure. It was plainly evident that the lingual plate was cut away.

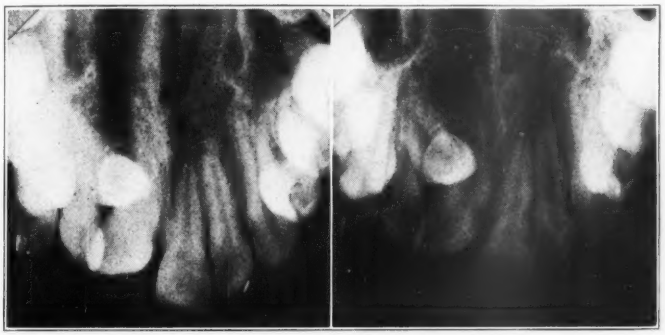

Fig. 8.—A supernumerary tooth.

Fig. 9.—A supernumerary tooth, the position of which was checked at time of removal.

As a similar experiment was performed on the superior maxilla, with the same results, it can be safely said that, in looking from the lingual side, the main bone structure seen is that of the lingual plate, gree the appearance of the structure of the lingual plate of bone.

To the oral surgeon and the orthodontist, the position of unerupted or impacted teeth and the position of the different

Fig. 10.—Film taken to follow the movement, if any, of the supernumerary tooth. Figures 10, 11 and 12 are a series of the same case.

Fig. 11.—View taken two months after Figure 10.

influenced somewhat by the labial plate of bone, which makes it appear a trifle more dense, this depending on its thickness, but not altering to any marked degree the appearance of the structure of the lingual plate of bone.

To the oral surgeon and the orthodontist, the position of unerupted or impacted teeth and the position of the different roots and their relation to one another are very important. The orthodontist is much more concerned with these problems, because, unlike the surgeon, he

must move these roots while they remain in the tissue, and must be sure of the relation of the roots, and work without seeing them except as shown by the roentgen-ray and clinical examination.

between the buccal and lingual plates. Five teeth were placed in this space in several different planes and their positions noted. The buccal plate was then replaced and the spaces around the teeth

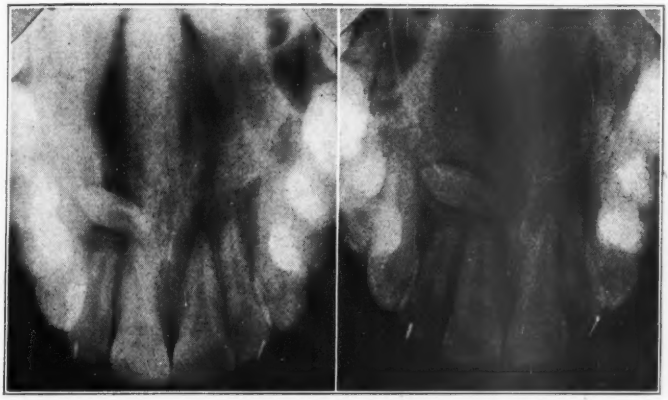

Fig. 12.—View taken nine months later than Figure 11.

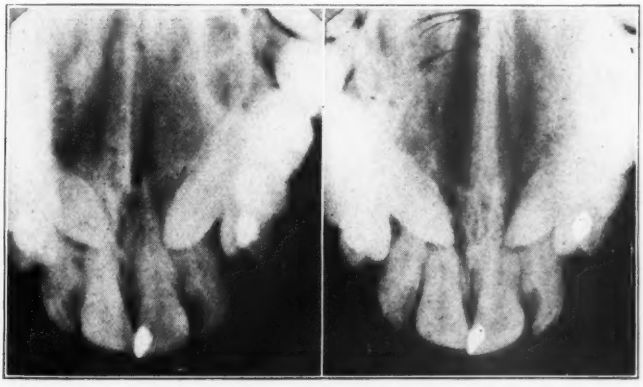

Fig. 13.—Impacted cuspids.

To determine whether the stereoroentgenogram will show the teeth to be in the planes in which they really are, the buccal plate of bone of a mandible was removed and also some of the structure and between the teeth and the bone were filled with paraffin. A stereoroentgenogram was then made. (Fig. 6.)

Five dentists, who were uninformed as to the true positions of the teeth in the

preparation, were asked to read the stereogram, and four of the readings agreed with the original record of the positions of the teeth. The fifth man varied from the reading in respect to one tooth, but otherwise his reading corresponded to the original record. The results of this experiment go to show that the stereoroentgenogram does indicate the teeth and structures in their true positions and planes.

Figures 7-17 show actual cases of impacted and supernumerary teeth. In a number of these, it was possible to check the positions at the time of removal.

As a diagnostic aid in locating a supernumerary tooth, the stereoroentgenogram is of greater value than a simple roentgenogram. In diagnosing a case, the stereoroentgenogram is not the only factor to be considered. Other dependable diagnostic facts must be used with it. These cases

Fig. 14.—Stereoroentgenogram of impacted cuspids taken to aid in making orthodontic attachments.

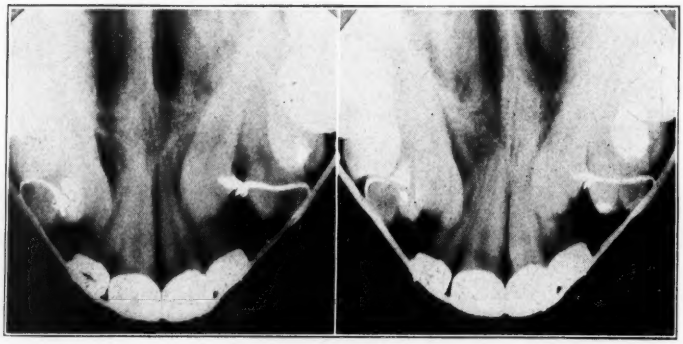

Fig. 15.—Case shown in Figure 15, after attachments had been placed.

have very forcibly brought to the mind the fact that, in interpreting a stereogram or a roentgenogram, a careful and exact interpretation is necessary, and that to obtain an exact interpretation, the film must be carefully studied and no judgments based on a passing glance.

In the investigation of bone changes taking place under the stimulus of an orthodontic appliance, four sets of comparative stereoroentgenograms were used. These were the four that were shown by check on the technic to introduce no variation from that source, and to eliminate any possible error due to technic, the other sets which did not check were discarded.

Because of lack of time and the difficulty of projecting such fine detail, I will show only one case in which there has been a change in the structure of the bone as a result of tooth movement in orthodontic treatment. (Fig. 18.) A labial arch and silk ligatures were used and, for experimental purposes, the movement of the incisors was begun immediately.

The patient was a boy, aged 12 years. Both control and comparative pictures

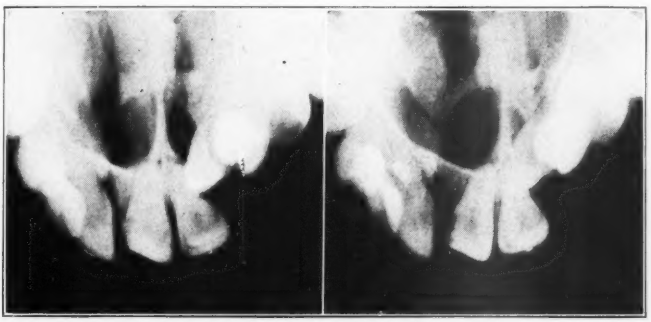

Fig. 16.—Cleft palate case.

Fig. 17.—Cyst.

were exposed six seconds at 10.5 milliamperes and developed six minutes with the developer at 65 F. The second picture was made eighty-five days after the first and seventy-seven days after force was applied, there being a period of eight days between the first picture and the application of force. (Fig. 19.)

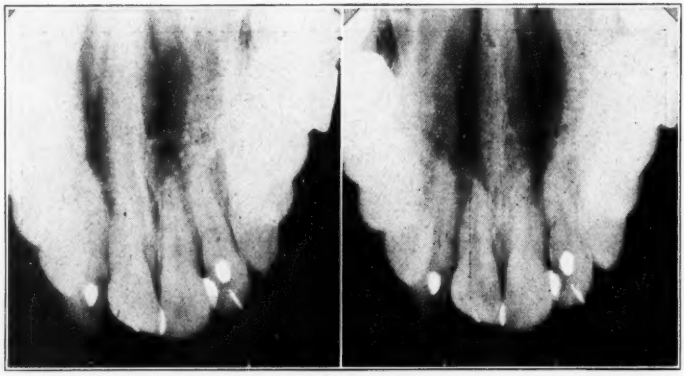

Fig. 18.—Comparative stereoroentgenogram before treatment.

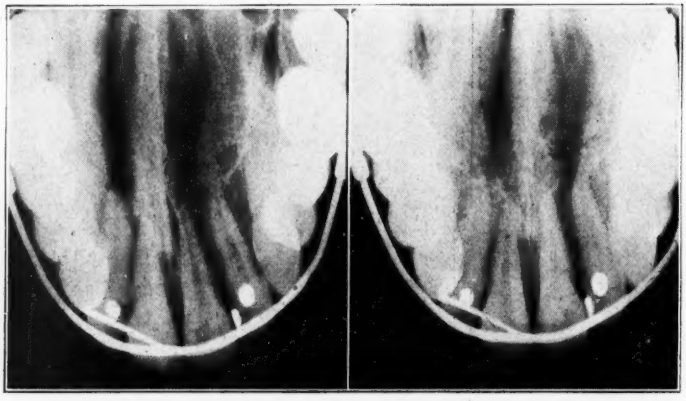

Fig. 19.—Comparative stereoroentgenogram after treatment.

My discussion and inferences which follow include all four cases referred to above. In a comparison of the stereoroentgenogram of each case, before orthodontic treatment and after treatment had been in progress a sufficient length of time to produce movement of the teeth, changes in the peridental membrane, lamina dura and the bone structure were demonstrated where tooth movement had occurred. The teeth which had not moved showed no change in any of these structures.

In the stereoroentgenogram before treatment, variations in the uniformity of the peridental membrane appear. In

some places, the peridental membrane is indiscernible, and, in others, it is exceptionally thick, and the uniformity varies in different positions between these two extremes. In the second stereoroentgenogram, there is still variation in uniformity, but the variations, in many instances, are opposite to those of the first stereoroentgenogram, and in other instances, an entirely different variation appears.

The difference in uniformity of the peridental membrane before treatment is the result of the occlusal stress and the different stresses resulting from the crowding of teeth as the erupting teeth attempt to force themselves into spaces too small for them. When a tooth is out of alinement, the peridental membrane is thin in places and thick in others, because, at the point of the fulcrum, the peridental membrane is compressed, and, on the side away from the pull, at the point farthest away from the fulcrum, it is thickened.

When pressure stimuli are applied, the fulcrum is changed and the forces applied act in new directions. This results in a compression of the peridental membrane in some areas and an elongation of the fibers of the peridental membrane in other areas. The stimuli are transmitted, through the attachment of the fibers of the peridental membrane, to the bone, and as the osteoclasts and osteoblasts become busy, a change takes place in the lamina dura.

In areas where, in the first stereoroentgenogram, the lamina dura was absent or scarcely discernible, in the second stereoroentgenogram, in many instances, it is present or more distinct. Where change is occurring in the tooth socket, the lamina dura becomes more dense or less dense as the case may be. The change in the lamina dura, in the comparison of the comparative stereoroentgenograms, is related to the change in the peridental membrane, and the bone structure. Its relation to the peridental membrane is not so nearly constant as is its relation to the bone structure.

The comparative stereoroentgenograms show that, in several instances, the irregularly shaped spaces of the bone structure have changed to round or oval. Long, narrow spaces, in certain areas, in the first stereoroentgenogram, are round or oval in the second. This fact is good evidence of an opposite arrangement of bone layers, for, in the first instance, we are observing the long dimension of a cylinder, and, in the second instance, the diameter of the cylinder.

The variation of the number of spaces in the two stereoroentgenograms compared show a rearrangement of bone layers. In some definite areas, the number of spaces is approximately the same in each stereoroentgenogram, but, in these instances, the network of bone spicules in the comparative stereoroentgenogram is much more dense, and the spaces are necessarily smaller.

Where originally there were small bone spaces, the spaces in the comparative stereoroentgenogram are larger, and the reverse is true where the spaces originally were large. In the rearrangement, the general shape of the spaces has also been changed. In general, there is a change in the bone structure wherever there has been tooth movement. The general rearrangement of the bone layers has a tendency toward an opposite arrangement, as shown by the spaces and intervening network of bone layers.

There is no definite arrangement which can be applied to all cases, but every case has its own individual arrangement. This is no doubt due to difference in stress of occlusion and difference in pressure stimuli, since it is impossible to

reproduce exactly the same conditions in the mouths of two individuals.

The changes do show that a rearrangement of the bone layers is occurring, as evidenced by the change in shape, number and size of the spaces between the layers and by the different directions assumed by the new bone spicules. This satisfactorily supports the evidence of the opposite arrangement of the bone layers, when pressure is applied to the crowns of the teeth, which has been shown microscopically by Oppenheim.[4]

Naturally, the stereoroentgenogram does not show this arrangement so definitely as the microscopic slide would, but it does show that the change in general is gross enough to be seen in viewing the stereoroentgenogram.

This should make the stereoroentgenogram valuable as a check on treatment to determine whether the force applied is producing a physiologic tooth movement.

CONCLUSIONS

1. Any interpretation of stereoroentgenograms should be made only after a prolonged study and consideration of all the possibilities of mistaken interpretation.

2. It is possible, by the technic used in this investigation, to produce two sets of stereoroentgenograms of the same patient, at different sittings, which will present the structures roentgenographed in exactly the same relative positions, and, therefore, make possible comparisons of changes taking place in these structures.

3. In viewing a stereoroentgenogram from the lingual aspect, the main bone structure seen is that of the lingual plate influenced somewhat by the labial plate of bone, but not altering, to any marked degree, the appearance of the bone structure of the lingual plate.

4. The stereoroentgenogram presents the tooth and bone structures more correctly in their spatial relations than does the single roentgenogram.

5. The advantage of the stereoroentgenogram lies entirely in adding one new factor of interpretation—depth.

6. The change in the bone structure, resulting from the movement of teeth in orthodontic treatment, demonstrated by means of comparative stereoroentgenograms, is characterized by a tendency toward an opposite arrangement of the bone lamellae, indicated by changes in the network of bone layers, and emphasized by the unchanged arrangement of the bone structure where there is no tooth movement.

4. Oppenheim, Albin: Tissue Changes, Particularly of the Bone, Incident to Tooth Movement, Am. Orthodontist, 3:57-67, 113-132, 1911.

EFFECTS OF ULTRAVIOLET, VISIBLE AND INFRARED IRRADIATION ON TISSUE, WITH SPECIAL REFERENCE TO THE PARATHYROID GLANDS AND CALCIUM METABOLISM*

By CHARLES SHEARD, Ph.D., Sc.D., Rochester, Minn.

IN one of the opening paragraphs of the monograph, "The Physiological Effects of Radiation," Laurens[1] wrote:

Those interested in the biological and therapeutic action of ultraviolet, visible and infrared radiations are often discouraged because of inconclusive or conflicting results, and above all because of an inability to more than hint at plausible reasons for the reactions obtained on normal and abnormal animals, organs or tissues. The biologist and clinician, however, should not feel discouraged, for there seem to be but few instances of photochemical effects where the physical process is understood. Furthermore, the lack of agreement between practical and therapeutic results on the one hand and scientific or experimental on the other is due to the fact that the experimental observations have been made for the most part on healthy men and animals, while the practical or therapeutic results have been obtained on diseased persons. The sick organism is a much more delicate mechanism than the well, diseased tissue being much more susceptible to radiation than normal, while the animal skin is an entirely different organ from the skin of man.

While but relatively little regarding photochemical processes is known, it is believed that they are the only means by which one can store up the energy from the sun's radiation (or from artificial sources of radiant energy such as carbon arcs, quartz-mercury lamps and the like) in the form of useful work, and their products are the greatest objects of the struggle for existence. For, as Nernst[2] expresses it in the closing paragraphs of his treatise on theoretical chemistry:

The struggle for existence is therefore, as Boltzmann emphasized, not a struggle for fundamental material—the fundamental material for all organisms is present in excess in earth, air and water; it is not even a struggle for energy itself, for quantities of energy fill our environment in the inconvertible form of heat; it is a struggle for the *free energy available for work*, which the plant world stores up from the sunlight, as electrical energy is stored in an accumulator. . . . There can be no doubt that a thorough explanation of the *transformation of radiant energy into chemical* would be a success of the highest importance and a further step towards the goal which theoretical chemistry even now makes possible, of placing side by side and in perfect equality with the doctrine of the *material* changes of nature, so long the chief interest of the scientist, a *doctrine of transformations of energy*.

PHOTOCHEMICAL ACTIVATION

As the result of the experimental work carried out with my colleagues, I have formulated the theory that vitamins are not necessarily new substances but may

*From the Division of Physics and Biophysical Research, The Mayo Foundation.

*Read before the Section on Oral Pathology at the Midwinter Clinic of the Chicago Dental Society, Chicago, Jan. 14, 1930.

1. Laurens, Henry: Physiological Effects of Radiation, Physiol. Rev., 8:1-91 (Jan.) 1928.

2. Nernst, Walter: Theoretical Chemistry, Ed. 5, London: Macmillan and Co., 1923, p. 902.

simply be certain atoms and molecules which have been photo-electrically or photochemically activated. According to modern electronic theories, this activation of inert atoms and molecules may be conceived of as being due to the fact that energy contained within certain wave lengths of radiant energy ionizes (that is, either causes an addition or a subtraction of an electron or changes the energy level of an electron according to the Bohr theory) atoms in complex chemical substances and thereby endows them with new activities, properties and powers. After all is said and done, an ionized atom or molecule of calcium, phosphorus or what not is not the same entity as a nonionized molecule or atom, for the ionized molecule or atom has, figuratively speaking, its arms wide open to grab, whereas the nonionized substance has its arms folded and is, so to speak, at rest chemically.

The vitamins, such as vitamin D (which is manufactured by the invisible rays of sunlight, carbon arcs or quartz-mercury lamps or is found in fresh, good quality cod liver oil) are doers, workers and energizers. They may simply be active forms of complex molecules of the mother substances, or, again, they may be catalyzers, i.e., substances that act as go-betweens, or handers-on, and which take the unavailable and mysteriously make it available. Perhaps they are substances which act like the trigger in the gun, which, when it is pulled, sets free the pent-up and previously unavailable energy of the gunpowder.

THE PHYSICAL PROBLEM

Investigators are now in possession of a great deal of general knowledge pertaining to the effects of radiant energy but are somewhat lacking in specific details, such as spectral limits, spectral distribution of energy and the spectral character of the radiant energy employed. The absence of data pertaining to the source employed and the nature and amount of radiation, are the cause of the contradictory nature of many of the therapeutic and experimental results that have been published. For instance, the distribution of energy in the various lines of the quartz-mercury arc lamp can be modified greatly by the input of energy (dependent on voltage and current), whether water-cooled or air-cooled, and on the presence or absence of selective filters. And, again, a Simon-pure source of ultraviolet (in which all visible and infrared portions of the spectrum are excluded) has never been used, to the best of my knowledge, in therapeutic work. Dosage, therefore, and therapeutic results must be dependent on the quality and quantity of the radiant energy absorbed by the tissue. Since it is very difficult to determine the percentage of incident radiant energy absorbed by any tissue, one must be satisfied at the present time with the determinations of the quality and quantity of radiation incident at the site of irradiation and the correlation of such measurements with biologic and clinical observations. It is easily conceivable that normalcy of functions of a given tissue might be stimulated by a certain quantity of radiation of a given spectral character, but that dysfunction or vital impairment might occur under excessive or lethal dosage, or, again, no demonstrable effects might be obtained because of insufficiency of radiation.

THE BIOLOGIC PROBLEM

The physical problems regarding quantity and quality of radiation can be solved satisfactorily. With roentgen rays, quartz and visible spectroscopes and other physical apparatus, data can be obtained

regarding the quality of the radiation. With spectrophotometers, monochromators and thermopiles, and ionization chambers, one can measure the quantity of the radiation in any specified spectral line or region.

The biologic problem is much more difficult. These difficulties, in brief, are as follows:

Supplies and Demands; Excesses and Deficits.—The general philosophy of the law of supply and demand is just as applicable to the animal or plant organism as to the world of finance. The strength or weakness of a business institution can be ascertained fairly readily by obtaining an accurate record of such assets and liabilities. It is difficult to obtain an accurate record of such assets and liabilities in the case of animal and plant organisms; for, as has been pointed out, the sick organism has a mechanism differing from the one that is well. It seems to me that those who practice in any wise on the human body frequently fail to appreciate the fact that certain symptoms, such as those included under the term discomfort, as well as untoward effects produced by certain causes, such as focal infections, are somewhat in proportion to the presence or absence of a state of well-being. In brief, when functions are strong and possess ample reserves, they are capable of meeting demands or of offsetting deficits, which would be impossible when these functions are weak. The biologic problem is, therefore, the determination of the quality and quantity of the reserves and of the deficits.

Environmental and Hereditary Factors.—In an article appearing recently,[3] I was quoted as saying: "Mr. Heinz with his fifty-seven varieties of pickles has nothing on the biologist, biophysicist and biochemist as they endeavor to draw conclusions relative to the effects produced by such an agent as ultraviolet light." No, indeed, Mr. Heinz has not made a start, for we have fifty-seven (or more) varieties of ancestors, environment, habits, diets, mental outlooks, nervous constitutions, etc. There are susceptibilities and immunity or developed resistance, tendencies to weakness or elements of strength. Therefore, to a very large extent, each patient as he presents himself to the physician or dentist is a distinct problem and a law unto himself. The biologic spread is a wide one. If a certain type of treatment can be shown to be efficacious in a reasonable percentage of cases, one can well believe that such knowledge is of value and will form the basis for further investigations covering the types which respond favorably or unfavorably.

Conclusions Drawn from Experimentation on Animals and Plants.—The skin of an animal is, in many respects, different from the skin of a man. Again, it is a long, long way from an ameba or paramecium to a man. Investigators get clews and first-hand information from experiments on animals. Although one cannot, for example, draw absolute conclusions from animal experimentation relative to the effects of radiant energy (as to both quality and quantity) on the human subject, in calcium and phosphorus metabolism, the growth and development of the parathyroid glands, etc., under controlled conditions, one can find out much regarding the factors involved in the prevention of rickets and the development of normal calcification and normal parathyroid glands.

3. Ingalls, A. G.: Ultraviolet Transmitting Glass; Has It Made Good? Sc. Amer., April, 1929, pp. 338-343.

THEORIES OF ACTION OR EFFECTS OF ULTRAVIOLET IRRADIATION

Some of the theories regarding the effects of ultraviolet irradiation may be summarized thus:

1. The fats and lipoids of the skin become photo-active after irradiation (Harthausen, Hess and Weinstock, Steenbock and Hart).

2. Ultraviolet radiation coagulates albumin, destroying superficial cells with liberation of ferments and their subsequent absorption (Pincussen).

3. Ultraviolet radiation increases the hemobactericidal properties (Colebrook, Hill, Eidinow and others).

4. Fluorescent substances in the skin, such as quiniodin, when irradiated become toxic to micro-organisms and this toxic substance can stimulate nerve endings (Dixon).

5. Radiant energy acts only in proportion to the total energy absorbed (Grotthus).

6. Ultraviolet light increases absorption of calcium and phosphorus of, or in, the intestines, probably owing to the effects on metabolism caused by the absorption of irradiated cholesterol from the skin (Webster, Hill, Robinson and others).

7. Ultraviolet radiation induces changes in the electrical condition of protein, altering the hydrogen-ion concentration; that is, a form of protein shock (Duke-Elder, and others).

8. On being oscillated, cells convert the oscillations into nerve stimuli. From this stimulation, erythema is indirectly produced.

9. Hypertrophy of parathyroid glands occurs after exposure to ultraviolet rays (Grant and Gates). Normality of development and function of the parathyroid glands are dependent on the presence of both ultraviolet and visible rays; whereas, hyperplasia and hypertrophy of the glands occur under either ultraviolet rays or the lesser or the greater wave length portions of sunlight when chickens are fed a ration poor in antirachitic vitamin (Sheard and Higgins).

10. The nuclei of cells are particularly absorptive of ultraviolet energy. The subsequent toxin derived from the splitting up of the chromatin brings about an increased blood supply (Hill).

11. Ultraviolet irradiation temporarily paralyzes the sympathetic nerve endings in the skin, which causes tonic depression of the whole sympathetic system. The result is inability of the suprarenal glands to convert tyrosin into epinephrin. Instead, this tyrosin is converted into melanin in the skin (Hertel, Rothman).

12. Effects are due to photo-electric and photochemical actions, and production of ions and of activated compounds. Quantum levels of electrons may be changed under ultraviolet irradiation and the resultant reradiation of energy permits this process of activation to continue for extensive periods (Sheard, Baly, Bovie).

13. Ultraviolet irradiation causes activation of ergosterol. This substance has no calcifying action, but when exposed to ultraviolet light of certain strength and for certain periods, it has a calcifying power which is at least a hundred thousand times as great as that of ordinary cod liver oil (Hess, Windhaus, Rosenheim and Webster).

14. Ultraviolet rays act by producing inflammatory reactions with the determination of more blood, lymph and lymphocytes to the part, and by altering the immunizing power of the body (Hill).

At any rate, life is a dynamic relationship between structure and environment. The cell is the unit of life and is essen-

tially a transformer of energy. In fact, the living cell may be regarded as a large electrified molecule surrounded by a shell of attendant positive or negative ions. Starting with the epoch-making suggestion of Planck that radiation is emitted in discrete units proportional to the frequency, Einstein was led to formulate the idea of corpuscular quanta of radiation or photons in order to account for the photo-electric effect. Recent experiments by A. H. Compton, Davisson and Greiner, and Dempster, using roentgen-rays, negative electrons and positive ions, respectively, have seemed to establish this corpuscular theory. Yet it has been known for a long time that light has the characteristics of waves. So, today, one continues to think that radiant energy (electric waves, infrared, visible, ultraviolet and roentgen rays) is propagated as electromagnetic waves, yet the energy of the light is concentrated in the particles associated with the waves. Hence, whenever light does anything, it does it as particles. The energy of the particles of the light waves, when absorbed, modifies the content and distribution of energy in the substance which absorbs it.

The human body is a myriad of cells: its covering, the skin, is everywhere studded with sensitive spots, or eyes, and each of these groups of receptors is tuned to radiations of definite range of wavelength. The influence of this reception of energy is conveyed internally to millions of cells situated in different tissues. This energy of radiation, largely from the sun, the great light "created in the beginning," changes matter (which is, in the last analysis, nothing but condensed energy), alters it, evolves it and endows it with new properties.

Ultraviolet rays penetrate to the deeper epidermal cells but no farther. Therefore, ultraviolet light does not penetrate the organism deeply enough to reach the bones, for example, and hence cannot be thought of as the agent which acts directly on bone tissue or which affects the growth or differentiation of tissues. Its stimulating action must be transferred, therefore, in some manner, from the medium in which it is absorbed, the skin of the body, to the bones. In plants, for example, we find that illuminating one portion of a plant affects the differentiation and development of the parts not exposed to the light. Since plants have, as far as we know, no specialized nervous tissues and nerve systems to act as receptors of energy or as modifiers of such energy when absorbed, it may well be concluded that photochemical products are formed in both plants and animals and that these photoproducts, or "formative materials" as someone has called them, bring about the differentiation. And, as Bovie has suggested, it is not impossible that the action of light on the blood is similar to that of light on a photographic plate. On exposure of a plate to light, a latent image is formed which is due to photochemical reactions and which ultimately is developed and fixed with suitable chemicals to give the final image, or "negative" as it is spoken of ordinarily. Light acting on the blood stream produces photochemical reactions which may be conceived of as latent images in the blood, which, in turn, may be developed by the chemical interactions which occur in connection with the metabolic changes having to do with the differentiation of tissue.

BIOLOGIC EXPERIMENTS ON THE INFLUENCE OF RADIANT ENERGY ON CALCIUM AND PHOSPHORUS METABOLISM AND THE GROWTH AND DEVELOPMENT OF PARATHYROID GLANDS

There is a wealth of experimental evidence from both the animal and the clin-

ical standpoint to substantiate the fundamental value of ultraviolet irradiation in the prevention and cure of certain types of disease and to demonstrate its rôle in growth and nutrition. By reason of this wealth of experimental work, I shall present only some of the data and conclusions reached from the researches of my colleagues and me.

Effects of Winter Solar Irradiation and of Cod Liver Oil on the Production and Fertility of Eggs.—Hart, Steenbock, and their colleagues[4] had previously demonstrated that irradiation of hens with ultraviolet light results in abundant production of eggs, increases the lime in the shell and sustains hatchability at from 60 to 70 per cent. They found that the embryos from the eggs of irradiated hens contained nearly twice as much lime as those from nonirradiated hens. Higgins and I[5] carried on experiments with a colony of hens and cockerels divided into three equal groups. Group 1 was housed behind ordinary window glass with 2 per cent by weight of cod liver oil (Squibb's) added to the diet; group 2 was housed behind quartz-containing glass (vitaglass), and group 3 was housed behind ordinary window glass only. The diet fed throughout the experiment, which lasted from November to the following May, was the standard Wisconsin all-mash ration. We concluded that:

1. Sufficient ultraviolet light is transmitted by such quartz-containing glasses as vitaglass or helioglass in the winter months in Minnesota to keep the production and fertility of eggs at a high level.

2. Ordinary window glass screens out from winter sunlight radiation which is beneficial to the maintenance of high production and fertility of eggs.

3. It appears that these results are due either to the transmission of solar energy in the region of 290 to 320 millimicrons or to the greater transmission of the ultraviolet rays (from 320 to 400 millimicrons) of sunlight by quartz-containing glass.

4. The addition of 2 per cent of cod liver oil to the standard Wisconsin ration gives results the equal of or slightly superior to those obtained with winter sunlight passed through an ultraviolet transmitting medium.

5. From these experiments and from those of other investigators, there is evidence that the presence or absence of the antirachitic factor vitally affects the production, fertility and hatchability of eggs.

Effects of Selective Solar Energy, with and Without Supplementary Irradiation, on the Growth of Chicks and the Development of Parathyroid Glands.—Higgins and I,[6] in 1928, reported the results of investigations on the growth of chicks and the development of the parathyroid glands. In these experiments, chicks were placed in compartments which had windows with a southern exposure, fitted with about 10 square feet of amber, blue and ordinary glass and quartz-containing glass (vitaglass), respectively. Half of

4. Hart, E. B., and others: Nutritional Requirements of the Chicken; V. Influence of Ultraviolet Light on Production, Hatchability and Fertility of the Egg, J. Biol. Chem., 65:579-595 (Oct.) 1925.

5. Sheard, Charles, and Higgins, G. M.: Effects of Winter Solar Irradiation and of Cod Liver Oil on Production and Fertility of Eggs, Proc. Soc. Exper. Biol. & Med., 27:467-474 (Feb.) 1930.

6. Higgins, G. M., and Sheard, Charles: Effects of Selective Solar Irradiation on Parathyroid Glands of Chicks, Am. J. Physiol., 85:299-310 (June) 1928; abstr. Proc. Staff Meetings of Mayo Clinic, 3:74 (March) 1928. Sheard, Charles, and Higgins, G. M.: Effects of Selective Solar Irradiation on Growth and Development of Chicks, Am. J. Physiol., 85:299-310 (June) 1928; abstr. Proc. Staff Meetings of Mayo Clinic, 3:75 (March) 1928.

the chicks under each filter were fed the Wisconsin basic all-mash ration (deficient in vitamin D only). The other half were fed this ration plus 2 per cent by weight of cod liver oil. Hyperplastic glands and subnormal weights were found within the first few weeks in chicks which were kept under the amber or blue filters when they were on the basic diet only. Normal glands and normal weights occurred in chicks which grew under quartz-containing glass (vitaglass). Normality both in parathyroid glands and weights was obtained under all the selective spectral filters when 2 per cent by weight of cod liver oil was added to the diet. From these experiments, it was concluded that there was evidence to support the statement that (1) cod liver oil (2 per cent by weight added to the diet adequate in all ingredients except vitamin D) is able to induce normal growth of chicks and of the parathyroid glands irrespective of the presence or absence of any portion of either ultraviolet or visible solar energy, and (2) normal growth and development of chicks and of the parathyroid glands, when the chicks are fed on a diet deficient in vitamin D, are dependent on both the ultraviolet and visible portions of solar radiation, all other factors remaining constant so far as is known.

In order to put to further test the statement that normal growth and development of chicks and parathyroid glands are dependent both on ultraviolet and longer visible portions of radiant energy, Higgins, Foster and I[7] carried on a second series of investigations in which we attempted to compensate for the absence of the shorter ultraviolet wave lengths of solar radiation (which are not transmitted by amber glass) through daily exposure of the chicks, constantly housed behind amber glass, to the radiant energy from an air-cooled quartz-mercury lamp for five, ten and fifteen minutes, respectively. In addition, two groups of chicks were housed behind purple corex glass (Corning Glass Company, G986A, 5 mm. thick), which transmits practically no visible light, but does transmit a goodly portion of the ultraviolet region (maximal transmission of 20 per cent at 330 millimicrons between 290 and 400 millimicrons).

If, then, energy in the ultraviolet region of sunlight, especially energy in the region of the so-called vita rays (from 290 to 320 millimicrons) is sufficient, in and of itself, to induce normal growth and development of chicks and of the parathyroid glands, it would appear that constant housing of chicks behind corex windows with a southern exposure should produce normality in growth, as evidenced by weight, and in the development of the parathyroid glands. Again, if both the visible and ultraviolet portions of solar energy are necessary for normal growth and glandular development, it would appear that sufficient supplementary irradiation by sources rich in ultraviolet radiation should cause development of normal conditions in chicks constantly housed behind amber glass filters. Without explaining the details of the experimental work and results, it may be stated that (1) irradiation with the air-cooled quartz-mercury arc lamp for ten minutes

7. Higgins, G. M.: Foster, W. I., and Sheard, Charles: Further Investigations on Effects of Radiant Energy on Development of Parathyroid Glands of Chicks, Am. J. Physiol., 94:91-100 (July) 1930. Sheard, Charles; Higgins, G. M., and Foster, W. I.: Growth and Development of Chicks as Influenced by Solar Irradiation of Long Visible and Ultraviolet Wave Lengths, Respectively, With and Without Supplementary Irradiation of Various Types, Am. J. Physiol., 94:84-90 (July) 1930.

daily, of the entire bodies of chicks, constantly housed behind amber filters, induced normal growth and development of chicks and of the parathyroid glands (the energy of the ultraviolet irradiation in the region of from 260 to 320 millimicrons received from the quartz-mercury arc [operated at 90 volts and a distance of 50 cm.] during ten minutes is about 110,000 ergs for each square millimeter) and (2) the daily reception of ultraviolet energy in the vita region (from 270 to 320 millimicrons), amounting to 125,000 ergs for each square millimeter transmitted to the chicks through corex, produces approximately normal weights but permits hyperplasia, cystic degeneration and fibrous invasion of the parathyroid glands.

Under the experimental conditions employed, grade of stock used and ration fed in these investigations, the authors expressed the belief that:

1. Constant housing of chicks behind an amber glass filter, which transmits only the longer visible wave lengths of sunlight, definitely retards growth and development and allows hyperplasia, cystic degeneration and fibrous invasion of the parathyroid glands.

2. Constant housing of chicks behind a filter (red-purple corex glass) which transmits practically only the ultraviolet region (from 270 to 400 millimicrons), with maximal transmission of 20 per cent at 330 millimicrons, rarely permits normality in development and growth of chicks as evidenced by weight, and it induces hyperplasia, cystic degeneration and fibrous invasion of the parathyroid glands.

3. Normal weights and normal development of parathyroid glands are found in chicks constantly housed behind an amber filter and given daily supplementary irradiation for ten to fifteen minutes with an air-cooled quartz-mercury lamp operated at 90 volts and at a distance of 50 cm. (ultraviolet irradiation of approximately 575 ergs each second for each square millimeter).

4. Normal calcification of bones (as evidenced microscopically by the Becke method and by determining the percentage of calcium by weight) and normal weight of chicks resulted under several of the experimental conditions imposed relative to quality and quantity of energy, with, however, the presence of abnormal parathyroid glands. Therefore, the absence of evidence of rickets or of malnutrition does not argue for normality of parathyroid glands.

5. Further evidence is presented, therefore, to support the statement that normal growth and development of chicks and of the parathyroid glands are dependent both on the ultraviolet and visible portions of solar irradiation, all other factors remaining constant as far as is known.

My latest researches with Higgins (as yet unpublished) indicate that from twenty to thirty minutes of noon-day sun in the summer is sufficient to prevent the development of rickets, but that about twice this quantity of solar irradiation is necessary in order to produce normal parathyroid glands. In the middle of winter, about five times as much, or from two to five hours' exposure to outdoor sunshine would be necessary. As far as chickens are concerned, about twenty minutes' daily irradiation with powerful sources of ultraviolet light is sufficient to compensate for the absence of ultraviolet rays in the environment of chickens housed behind filters which absorb the ultraviolet in the so-called vita region (from 290 to 320 millimicrons).

THE POSSIBLE VALUE OF RADIANT ENERGY IN DENTISTRY

The teeth are special structures which also come under the influence of the glands of internal secretion and, therefore, of radiant energy, especially ultraviolet irradiation. There is a close resemblance between the structure of teeth and of bones, in the mechanism of their calcification and in their chemical composition.

During the studies at the Johns Hopkins University on rickets, Grieves paid particular attention to the dental conditions which develop in the experimental animals and he speaks especially of dental caries. Grieves believes that the essential factors making for dental caries according to the modern concept are environmental. It is not denied that structural defects may be contributory, but the dominant pathology involves the integrity of calcium assimilation whether it be the result of infection, or vitamin-deficient food, or the disturbance of the calcium balance of the blood, due to insufficient and improper radiation.[8]

Quartz-mercury and carbon arcs are being used in both clinical and experimental dentistry, looking toward alleviation of, if not a cure for, pyorrhea. There are those who employ ultraviolet irradiation of the entire body for the promotion of general calcium metabolism and as a combatant of infection and unphysiologic conditions. Others are limiting their use of radiant energy to localized treatment, including possibly the whole of the oral cavity. Humphris[9] wrote: "There is no doubt that, by a daily application of ultraviolet radiation, this condition (pyorrhea) can be very much improved or at least checked. It can be even cured symptomatically, but I have yet to see a case of true pyorrhea cured permanently by its means." The rationale of the treatment with ultraviolet radiation is not peculiar to the treatment of pyorrhea. It presupposes, in the first place, destruction of the invading bacteria by the bactericidal action of the radiant energy, and, in the second place, such stimulation of the surrounding tissues as to enable them successfully to resist bacterial invasion and its consequences.

It is my opinion that both general and localized irradiation with quartz-mercury or carbon arcs may be used judiciously as an aid to or as an accessory factor in the attempt to establish normality of function of tissues and as an agent which combats the untoward effects of an unphysiologic environment or a tendency to certain pathologic conditions. Unless radiant energy only is used, with a definite technic and a knowledge of the quality and quantity of energy employed, it would seem to be illogical to draw conclusions regarding the efficacy of such energy *per se* in the treatment of any abnormal condition. That radiant energy has possibilities as a prophylactic agent is indicated definitely by numerous investigators.

Superficial pain, as well as that in deeper structures, can be relieved by ultraviolet radiation. This relief may be due to the superficial hyperemia produced or it may be the result of counteracting the irritation of the peripheral nerves of an area, in consonance with the view that there is a reflex relation between many areas of cutaneous, surface and internal organs. It is an important therapeutic property of ultraviolet energy to allay pain.

CONCLUSION

It is possible that the use of various types of artificial sources of light rich in

8. Luckiesh, M., and Pacini, A. J.: Light and Health, Baltimore: Williams and Wilkins Co., 1926 (p. 109).

9. Humphris, F. H.: Artificial Sunlight and Its Therapeutic Uses, New York and London: Oxford University Press, 1926 (p. 183).

ultraviolet radiation of sufficient quantity and of proper spectral character may be an aid to dentistry:

1. As an accessory agent to assist in inducing and maintaining normal calcium and phosphorus metabolism so that normal calcification may ensue.

2. As a germicidal agent, since the bactericidal action of ultraviolet rays has been observed and reported by many different investigators.

3. As an agent that induces an increased supply of blood to an area which has been locally treated.

4. As an analgesic agent, for the relief of pain in both superficial and deep structures.

5. As an agent which may increase the number of red and white blood cells and the percentage of hemoglobin.

6. As an agent which tends to establish normality of function of tissues and which combats the untoward effects of an unphysiologic environment or a tendency to certain pathologic conditions.

SIGNIFICANCE OF ENDOCRINE AND VITAMIN DEFICIENCIES AS ETIOLOGIC FACTORS IN DENTAL ABNORMALITIES*

By HANS H. REESE, M.D., Madison, Wis.

I HAVE little to present in the way of information with which you are not familiar. The title of my paper, "The Significance of Endocrine and Vitamin Deficiencies as Etiologic Factors in Dental Abnormalities," refers to two phases of modern medicine each of which is a science in itself with many unknown factors and attended by much speculation. In the present status of our knowledge, there is a tendency to admit that almost all the endocrine glands exert an influence on the growth, on the formative processes of structural integrity, on the metabolism and, finally, on the biochemical functions of cells or cell complexes. These have been carefully studied in clinical cases and have introduced such terms into medical literature as Graves' disease (exophthalmic goiter), Addison's disease, acromegaly and diabetes. Further investigation in close cooperation between the clinic and laboratory has shed more light on the actions of the endocrine glands, resulting in the determination of their secretory products, called hormones. We speak now of a hyperfunctional or hypofunctional activity of the gland and support our clinical findings with special chemical and pharmacologic tests.

What clinical observation has accomplished in the field of endocrine disturbances it has also accomplished in the field of so-called dietary deficiencies. We know that beriberi, the endemic form of polyneuritis; pellagra, an endemic skin and cerebrospinal disease, and scurvy, with its swollen, ulcerated gums, are the results of faulty nutrition. Again, the cooperation between clinicians and re-

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search laboratories culminated in the determination that such disorders were caused by the lack of certain accessory food substances. The last discoveries were the vitamins and their source of distribution in nature. The problem, "What is the chemical nature of these accessory food factors and how do the vitamins exert their characteristic effects in the body?" is not yet solved.

To account for the rapid destruction of the teeth and especially of the enamel among civilized people, much laborious work has been done. We have to discard neglect and lack of cleanliness as the main cause of dental caries because we often see excellent teeth in a dirty, neglected mouth which never has known the use of a toothbrush, an alkaline tooth powder or an antiseptic mouth wash, or experienced the competent service of a dentist. And again we see widespread caries in the mouth in which all laws of oral hygiene have been employed throughout life. The acid and bacterial theories of W. D. Miller do not explain dental caries completely and have been abandoned by most of us since the advancement of biochemical and structural pathology. Miller, especially in his bacterial theory, suggests that proteolytic enzymes destroy the cementing material of the enamel rods by altering its protein character. Such a chemical process could produce small and large areas of caries in the enamel just as well as in the dentin.

To arraign faulty diet as the most important factor in progressive destruction of the teeth, especially of the enamel, is unjustified, because improper food is not the exciting cause. Probably, the diminution of the utilizing power of the body brought on by a hormonic imbalance of the endocrine glands is a predisposing cause.

For the sake of clearness and brevity, I will explain the action of a few of the ductless glands which, in my opinion, have important functions in regard to the questions in which we are interested. It is incorrect to blame one gland for the disturbance because all endocrine glands regulate the development of an individual and control the various metabolic functions. The physical and mental development, the constitution and the cell functions of a person will diverge from its normal course because of an endocrine unbalance, exogenous forces, such as nutrition and diseases and, finally, psychic and mental influences, according to Cannon and Crile. The endocrine glands are acting as an integral system; that is, they influence and control systems of locomotion, of metabolism, of brain activity. They are able, also, to act qualitatively and quantitatively alone, this being dependent on the epoch of life during which hyperfunction or hypofunction of its action is required. Deficiency of one or several glands at certain periods of life will result in general retardation in the form of physical deficiencies and abnormalities or in nervous and mental manifestations. During the period of early childhood, harmonious interaction of thymus, thyroid, parathyroid, pituitary and pineal glands builds up the individual physically and intellectually. During the adolescent period of life, secreting gonads are essential to usher in puberty and maturity. The secretion of the thyroid gland is an essential factor in maintaining the normality of both body and mind. It regulates the constructive assimilation, or anabolism, as well as the destructive metabolism, or katabolism. These abnormal functions are well illustrated in the hypofunction of this gland, which is known as cretinism in the child and myxedema in the adult. Either con-

dition may result from a hypoplastic thyroid gland or from lack of secreting hormones. In cretinism, we find besides arrested skeletal and body growth, a marked retardation of the mental capacity. The hair is sparse and dry, the finger nails are often brittle and broken and the skin is dry and scaly. The outer half of the eyebrow is often absent. Myxedema frequently presents dental anomalies, such as delayed, irregular eruption and malposition of the first and second teeth. My observations do not justify the acceptance of a specific dental abnormality or caries in myxedema because I find the same dental pathologic processes in cretinism and myxedema as I have noted in other types of cases. Thyroid feeding in these conditions will improve the deficiencies, will hasten the eruption of the deciduous teeth and will hasten the second dentition. The thyroid in cofunction with the pituitary gland regulates the fat distribution throughout the body. In hypothyroidism, the obesity is uniformly distributed; whereas, heavy fat deposits around the pelvis accompany pituitary deficiencies. Fat legs and well-padded ankles in an obese individual indicate hypothyroidism, in contradistinction to hypopituitarism with normal legs, slender ankles, small hands and feet. The thyroid is said to be the pacemaker of the endocrines during the different developmental phases of the growing child. There is a very intimate relationship between thyroid and sexual functions, especially in women. The gland is usually larger in woman than in men. A transitory compensatory enlargement is seen frequently during puberty, menstruation and pregnancy. The relationship between the thyroid and the parathyroid is important during pregnancy. During this time, a woman needs a greater supply of calcium and potassium, and her mineral poverty will be manifested in brittle nails, decay of teeth and loss of hair. This means that the thyroid is not sufficiently stimulating the parathyroids, which regulate the calcium metabolism. Myxedema develops slowly, with general malaise, weakness, mental hebetude, lack of concentration and a gradual gain in weight. The facial expression becomes stupid on account of the myxedematous deposits around the eyes and in the cheeks. The tissues are pale and flabby. The hair of the body is partially lost, and the patient becomes listless and even unsteady. Perspiration and sebaceous secretion is deficient.

The hyperfunction of the thyroid is well known to you in the case of exophthalmic goiter, in which the thyroid secretion has developed toxic properties. Between the true hyperfunction and the hypofunction of the thyroid, there are a wide range of cases which do not fit into the clinical classification of exophthalmic goiter or myxedema. These borderline cases are very difficult of interpretation. In obscure and multiform complaints of adults or in children showing a lack of mental development, one always should keep in mind the possibility of an impaired thyroid function and should, after careful investigation of the case, insist on a test of the basal metabolism, which is increased in hyperfunction and decreased in hypofunction. The normal range of the basal metabolism is between +10 and —10, although we consider readings approaching the extreme limits of this range as pathologic.

The parathyroid bodies, located behind the thyroid, are generally recognized as controlling the calcium metabolism. A hypofunction, or loss of secreting functions of these bodies, results in tetany, a disease characterized by painful, tonic, symmetrical spasms (cramps) of the

muscles of the hands and feet. It occurs in individuals usually between 15 and 25. The cause is unknown, but it often occurs after infectious diseases and in rickets, and is seen following thyroidectomy, when, by mistake of the surgeon, the parathyroid bodies have been excised. These individuals first complain of a tingling sensation in hands and feet, of twitching muscles and then suddenly have symmetrical cramps in the extremities. The excitability of the muscles can be determined by tapping of the facial nerves, which results in twitching of the muscles around the mouth; by firmly compressing the nerve trunks on the inside of the arm or thigh, which will elicit a cramp, and, finally, by the electrical irritability of the galvanic current. Tetany is due to lack of floating calcium in the system as demonstrated by a low calcium content of the blood serum, usually below 5 mg.; whereas, the normal amount of calcium in the blood is between 9.5 and 12.0 mg. per hundred cubic centimeters of serum. Erdheim stated that between the sixth and tenth week after the removal of the parathyroid, opaque white spots appear on the outer surface of the upper and lower incisors. These spots move upward from the biting edge as the teeth grow. They are circumscribed defects in enamel, which scales off, dental caries resulting. The teeth of individuals who have suffered from tetany in childhood show hypoplasia of the enamel.

The thymus gland is very important in the regulation of early mineral metabolism and skeletal growth. The gland is more active during infancy and ceases to function approximately around the sixteenth year of life. The thymus in newborn babies with a well developed skeleton is larger than in infants with a poorly developed skeleton. The thymus is much smaller in infants who are undernourished and who are suffering from nutritional disturbances. Some physicians consider the thymus gland as the central organ for vitamin metabolism in infants because of the fact that avitaminosis produces physical and mental arrest. Additional feeding of thymus in this disorder results in satisfactory development. The thymus serves to fix calcium and thus has an antagonistic action through its hormone on those tissues which excrete calcium easily. Thymus deficiencies cause a delay in the development and eruption of the teeth and can produce abnormalities in children similar to rickets.

The ovaries regulate the menstrual cycle in close cooperation with the pituitary gland. We see individuals who bleed readily from the gums and nose during menstruation. Transitory toothache during the menses is sometimes an early sign of ovarian disturbance. I do not believe that these disturbances are directly caused by ovarian hormones, but I feel that they are evidence of a nervous constitution.

During menstruation, teeth should not be extracted because there is a greater disposition to hemorrhage. Mayrhofer[1] reports a case of a girl, aged 14, who had a severe alveolar hemorrhage eight days after an extraction, with cessation of menstruation. As soon as the postextractive hemorrhage ceased, a normal menstrual flow was established. In another case, he noticed that nine days after an extraction, the menstruation was accompanied by a severe hemorrhage from the alveolar socket. It is generally accepted that pregnancy is hard on the teeth, and you hear mothers say that each pregnancy has been attended by the loss of at least

1. Mayrhofer, B.: Lehrbuch d. Zahnkrankh., Jena, 1922.

one tooth. There is no uniform explanation for the frequency of caries during pregnancy. Some claim that the acidity of the saliva is the cause, as suggested by Miller, while others cite the calcium deficiency. A sign of the relationship between pregnancy and oral disease is seen in a soft, spongy gingiva.

Above the kidneys are small glandular bodies which are called the suprarenals. They are necessary to maintain life. The work by investigators in various branches of medicine has shown that they have two different aspects, anatomic and physiologic. The cortex of the glands harbors a wealth of lipoids, fatty bodies containing two active properties: lecithin, which is rich in phosphorus, and cholesterin, a monatomic alcohol lacking phosphorus. The hormone of the medulla is called epinephrin, an antitoxin according to Abelus and Langlois. According to Oliver and Schaefer, epinephrin raises the blood pressure and strengthens the cardiac activity. According to Sajous,[2] its fundamental function is the regulation of respiration and of tissue oxidation. Both the cortex and the medulla of the suprarenals exert an influence on the sympathetic nervous system as well as on the entire lymphatic apparatus. Hypoplasia of the suprarenal medulla is found in thymicolymphatic status, a condition presenting enlargement of the lymphadenoid tissue, generally with enlargement of the thymus. These are cases in which, under the slightest manipulation, sudden death may occur. It accounts for inexplicable deaths in young people during very minor surgical procedures. Deficiencies of the suprarenals are often associated with brain defects. The fact that a great deal of lecithin is found in the brain and nerves suggests that the lecithin metabolism is of importance in the development of the central nervous system. Insufficiency of the suprarenals is called Addison's disease, in which is seen marked pigmentation, especially those areas which are exposed to sunlight, and, in addition, spotted pigmentation of the oral mucosa. Associated with the brownish discoloration is muscular weakness, low blood pressure, gastro-intestinal upsets and mental lethargy. You are all familiar with the use of epinephrin in your dental work and know the beneficial results of its use in controlling hemorrhage in extractions.

The function of the hypophysis and its hormones will not be discussed in detail because of too many opposing theories as to its function. We know that hyperfunction of the anterior lobe of the gland results in acromegaly, with a tremendous overgrowth of the prominent bones, especially of the face, hands and feet. The marked overgrowth of the maxilla and mandible will enlarge the alveolar processes, and this enlargement often results in widespacing of all the teeth. Pituitrin acts as a very powerful stimulus on the sympathetic nervous system. It is used to counteract surgical shock and to stimulate uterine contractions in labor. In my description of the endocrine glands and their functions, I have followed carefully the work and theories of Hopewell-Smith,[3] who states that calcium metabolism is controlled by the parathyroids and the thymus and that these glands also increase the phospholipoids which have to do with the development of the body and mind. A deficiency of phospholipoids interferes with the solidification of the calcium phosphate

2. Sajous, C. E.: Endocrine Glands in Relation to Dental Nutrition and Caries, Dental Cosmos, 65:702-713 (July) 1923.

3. Hopewell-Smith, Arthur: Normal and Pathological Histology of the Mouth, Ed. 2, London, 1913.

of dental structures. If we summarize the functions of the hormones of the endocrine glands, we are confronted with mineral metabolism and nervous reactions. How much the one influences the other it is impossible to state clearly. The importance of balanced relationship between the different glands, which organize the assimilation of our body tissues, cannot be stressed enough.

The name "vitamin" was introduced, in 1912 by Funk,[4] who, from laborious studies of food materials, of diets and deficiency diseases, concluded that proteins, fats, carbohydrates, minerals and water, even in a physiologic ratio, are not always sufficient to maintain a nutritional equilibrium, but that accessory food substances, or nutritional hormones, are essential to insure normal development of the body tissues and a good state of health. Emil Fischer, McCollum,[5] Abderhalden, Bunge, Wilcox, Sir Frederick Hopkins[6] and Eijkman (Nobel prize recipients for their work on vitamins), have gradually developed, by animal experimentation and biochemical research, the theory that no animal can live on a mixture of pure protein, fats, carbohydrates and necessary inorganic materials if this mixture does not contain certain substances other than the above mentioned. They know that rickets, scurvy, beriberi and pellagra can be eliminated by dietetic measures, but they do not know the real causative deficiency in the diet in these conditions. Extensive research on both plants and animals with reproduction of deficiency disorders has permitted chemical, bacteriologic and pathologic studies of organs. This work has shown that pigeons suffering from so-called bird beriberi show distinct changes, among these the complete disappearance of the thymus. The collodial substance in the thyroid became reduced and the gland varied greatly in size and weight. Douglas, McCarrison and Funk have concluded from their work that the organs were altered and finally became atrophic in the following order: thymus, testicles, spleen, ovaries, pancreas, heart, liver, kidney, thyroid and brain. Whereas these organs were atrophied, the suprarenals were hypertrophied, an important observation which may explain the edema in deficiency disorders. Lack of vitamin E (reproductive or anti-sterility vitamin) exerts a deleterious effect on the sexual organs. In males, spermatogenesis ceases, and sterility results; in females, the menstrual cycle becomes irregular, amenorrhea finally resulting. Lack of vitamin A causes failure of ovulation; of vitamin E, failure of placental function, with death and resorption of the embryo. The food deficiency diseases, be they avitaminosis or hypovitaminosis, present distinct phases: chronic inanition, faulty assimilation, abnormal endocrine functions and disturbances of the central nervous system. Although clear cut findings in animal experimentation with vitamin deficiency have brought understanding in this important field of nutrition, medicine has been rather reluctant to acknowledge these facts in human beings. The human body is a complicated structure and our cellular functions are more highly differentiated than in animals. We need the vitamins—A, B, (1 and 2), C, D and E. Clinical observations in pediatrics by A. F. Hess, Byfield, Daniels and Loughlin parallel those in animal experimenta-

4. Funk, C.: Die Vitamine, Ed. 3, Munich, 1924.

5. McCollum, E. V.: Malnutrition Through Errors in the Combination of Food, Am. Food J., 2:404, 1916.

6. Hopkins, F. S.: Practical Importance of Vitamines, Brit. Med. J., 1:507 (April 26) 1919.

tion by Steenbock and others. Unfortunately, we do not know the chemical nature of all vitamins and we are unable to isolate the pure vitamins from food materials, with the exception of vitamin D, which has been synthesized and manufactured from ergosterol, a chemical compound found in food materials and the skin. All we know is that the vitamin properties are necessary to maintain a healthy body; that their addition to food is essential; that they are already active in small quantities, and that they are fairly stable against heat and chemicals. Deficiency in vitamins results in many pathologic conditions, such as reduced assimilation, faulty mineral metabolism, and lowered resistance against infections, with functional and pathologic changes in the different organs. Besides glandular reactions and secretions, skeletal growth, dental development and skin conditions are altered.

We are today interested in the influence of vitamins on the teeth. The clinical observations and theories of Black, McKay and Bliss, to name only a few, that faulty nutrition was the cause of caries has been confirmed by animal experimentation. The teeth are well adapted to experimental studies because they can be examined at any stage of their development. Pathologic formation and destruction can be seen early and can be analyzed histologically. This fact is important, for we can make deductions from animal experiments upon the developmental structural changes in human beings under similar conditions. If a diet is poor in vitamin A (found in cod-liver oil, dairy products and leafy vegetables), C (found in citrus fruits, raw cabbage, turnips, tomatoes), we see delayed, irregular dentition with malposition, defects in the enamel and dentin, and a low calcium and phosphorus content of the structures. It is the same picture as seen in vitamin D deficiency, or rickets. Therefore, the question arises: Are not vitamins A and D identical and the same accessory food hormone? Percy R. Howe experimented with the antiscorbutic vitamin, C, and conceded that this vitamin is of greater importance to the health of the teeth and jaws than vitamin A or B, or, as May Mellanby teaches, vitamin D. The fragility of bones and the dental decay were distinct in his studies. His experiments are especially interesting as he kept his animals alive for one year and was able to study the developmental stages, supporting his observations by chemical analyses. A fine piece of research work has been completed by O. Walkhoff, Berlin, who described his results in a booklet entitled "The Vitamins and Their Significance in the Development, Structure and Resistance of the Teeth Against Disease." He states that, after eight days, in guinea-pigs on a scurvy diet the osteoblasts become irregular and finally disappear in the pulp. The connections from the predentin to the dentin, the canaliculi, are destroyed. The odontoblasts are infiltrated with cells of the osteoblastic type. The dentinogenous zone becomes calcified early, forming a distinct line on the medial side of the dentin from which calcified predentin grows toward the pulp chamber, finally filling this space with new osteoid tissue. The latter does not contain dentin canals. In other words, the pulp tissue undergoes calcification and the odontoblasts disappear. The increased vascularization produces hemorrhages in the pulp and the dentin becomes soft through marked dilatation of its canaliculi. The early degeneration of the formative cells without a possible cellular substitution will make structural defects occurring during the developmental period permanent.

Apparently, the mechanism regulating dental growth is not dependent upon one vitamin alone but probably vitamins A and D are essential as regulators of the calcium, magnesium and phosphorus metabolism, whereas, vitamins C and B are necessary for the quality of the cellular structure.

Dental caries and malformation are not a disease in themselves, but, in my opinion, only a symptom of a complicated syndrome. Healthy teeth can be obtained by scientific nutrition in the developmental period, which should start with the expectant mother and should be continued during infancy and childhood. In addition, these periods have to be governed by the laws of hygiene. Alimentary disturbances, even of a very short duration, caused by either faulty diet or by disease, will produce disturbance of ossification and result in permanent defects of the enamel and dentin, with malformation of the alveolar processes. Illness and metabolic disturbances in the expectant mother undoubtedly affect the fast growing crowns of the deciduous teeth, producing defects in the enamel and dentin by temporarily paralyzing the activity of the odontoblasts. In our efforts to avoid, or at least to curb, dental caries, we have to eliminate the causes of dental abnormality. A well-balanced body with harmonious functions of the endocrines, a dietary containing sufficient vitamins, beginning in uterine life, and modern dental hygiene are essential to develop and maintain healthy teeth.

DISCUSSION

O. O. Stanley, Decatur, Ill.: By the very nature of endocrinology and dietary deficiency states, we are left much to our own devices as to diagnosis and treatment. The individual we meet today as a patient is the composite picture of the effects of the normal function, the hyperfunction or the hypofunction of these ductless glandular hormones, and of the proper supply, oversupply or deficiencies of the vitamins. Entirely aside from the scars of past disturbances in these two fields which the patient may show, we must concern ourselves also, and first, with actual organic disorders lying entirely outside their scope. It is in differentiating organic lesions from dysfunction or deficiencies of the catalytic necessities of the organism that we find our chief difficulties. In a not distant past, with great assurance and on meager data, we would pick out, even on the street, the various endocrine disorders patent to the discerning eye of our new knowledge. Today, we are more humble. A little more experience has been very illuminating and mystifying. Particularly to eliminate the psychic element, which presents symptoms simulating both the organic and the deficiency disorders, as well as many peculiarly its own, and to diagnose more accurately and to prescribe more effectively, we are compelled to resort to biochemistry for the foundation knowledge upon which we build the readjustment and cure of our patient. The basal metabolic rate, carbon dioxid, combining power of the blood, blood calcium, phosphorus, sugar, nonprotein nitrogen, urea, and even the hormone content of the blood may be necessary, with other possible procedures, to an adequate diagnosis. The last applies particularly to the endogenous catalysers, or endocrine hormones. To a more limited degree, the same observation may as well apply to the exogenous, vitamin, factors of growth and maintenance. However, more easily selected, proportioned, and accurately supplied, the vitamins, through a balanced diet, may eliminate the problems presented in rickets, scurvy, pellagra, and other vitamin deficiency disorders, and the time is at hand when the individual will be protected from such disease from early uterine life until he dies of old age. I trust that none of these observations may seem to you pessimistic. They are not so intended. Extremely puzzling, and challenging the best of our investigators, the results already are of great practical value, and portend solution of many of the problems which this group of disorders presents. Dentistry and medicine have much in common, in background and foundation, in professional ethics and ideals for the general welfare. Such presentations as this highly instructive one by Dr. Reese bind us more closely in our fraternal advance

to more thorough observation and more accurate deduction, to the end that all these problems are solved, and we shall approach the golden age when all disease is done away with by scientific prevention.

Paul L. Schroeder, Chicago, Ill.: Dr. Reese has referred, in a more general way, to the influence of endocrine and vitamin on the mental development. He has made specific reference to the limitation of intellectual abilities in the thyroid dysfunction in children and adults as in cretinism, exophthalmic goiter, myxedema and other conditions. In referring especially to the behavior of the individual, one is concerned not only with the direct influence of endocrine function and metabolism but also indirectly with the results of such functions. I would like to speak of the behavior difficulties resulting from the effects of these conditions. I am sure that if I ask you as a group of dentists to tell me what physical characteristic you remember best in people you meet, you will say, "It is their teeth." To the community taken as a whole, the eyes probably serve most commonly as a means of identification. After the eyes come the teeth. But they are more fraught with importance than the eyes because of what people are expected to do about them. Our dental hygiene and public health movement has made it almost a criminal offense to have teeth that deviate even slightly from the normal; whereas, everybody agrees there is nothing one can do about the color of the eyes. It is not only the teeth themselves but the jaws and the entire facies that are influenced by the dental deviations. The orthodontist should be just as much concerned with the general configuration of the face as he is with the masticatory function of the teeth. Alfred Adler, the Viennese psychiatrist, developed the concept of the inferiority complex. Its origin was based on the emotional reaction to real physical inferiorities. He observed that children early became conscious of any physical condition present in themselves which differed from the normal or standard for that community; that the individual reacted to this in one of two ways, by retiring into the background in escape or by compensating for it in another fashion. There was not infrequently an overcompensation as represented by the fighting of the child who has red hair. Now, it has not been proved that the reputation of aggressiveness among red haired people has been earned by them. Children whose teeth show enamel defects or deformities from any cause frequently cover their mouths with their hands in talking. Their smiling is usually hidden behind their fingers. Even though the child may be repeatedly reminded to remove his hand, he usually returns it to this position. The emotional stress which exists cannot be denied. The extent to which this disturbance may develop is unlimited. The person who is unable to accept this defect and has failed to compensate adequately for it may become greatly depressed and develop ideas of self-effacement. On the other hand, he may develop a form of compensation which is unwholesome or may extend to delinquency. The extent to which depression may develop in a young woman is shown in a case which has been reported by Dr. Schultz of Chicago.[7]

William A. Evans, Chicago, Ill.: We used to believe that all that was required to prevent dental decay, and to prevent pyorrhea, was to develop and maintain healthy teeth. I take it that we still believe that this is a prime requisite. We had two or three speakers during this morning who carried us a step back of that, and said that, in addition to the necessity of developing and maintaining healthy teeth, it was essential that we have a proper supply of vitamins, to regulate the calcium, magnesium and phosphorus, beginning in uterine life, and just as we were about half way convinced that we should do that, there comes the proposal that we should go a step farther back, and add to these two a third—that we must have in addition to these a proper regulation of the body, of the teeth and of the vitamins by reason of a proper endocrine balance. Dr. Reese's paper has put this thing before us in two phases, has caused our minds to run along two channels. The first is somewhat pragmatic: What can we do about it? What practically, is there done, for the improvement of conditions? And the second is, What is the philosophy that is involved? Practically, what are the things that have been suggested by Dr. Reese's paper? The first that comes to my mind is this: There is a fair literature to the effect that the thyroid gland and, in perhaps some measure, the thymus contribute to the

7. Schultz, Louis, and Willett, R. C.: Surgical Orthodontic Correction of a Macromandibular Deformity, J. A. D. A., 15:614 (April) 1928.

eruption of the teeth, and that in delayed eruption of teeth, we can, by giving a very minute dose of thyroid, a tenth or a twentieth of a grain, or even less, cause the teeth to erupt. We know a moderate amount only about endocrine therapy. As Dr. Stanley has said, there is a great deal of misinformation. We are rather oversupplied with remedies that have not been very definitely established. I believe that so far as most of it is concerned, we have arrived at the period of clinical experimentation, as distinguished from laboratory experimentation. Therefore, a part of this therapy has not yet progressed to the point where it is advisable to subject it to other than laboratory experimentation, and a part of it is ready for clinical experimentation; while, with reference to some of it, there is a good deal of quite scientific work done, pharmacologic, physiologic and even therapeutic work. There are remedies available, representing certain of the principles obtained from the parathyroid, but, frankly, they are not very well established. We do not know just where they can be improved, but there is every reason to believe that there is something in the idea, and that even though results up to the present may not be entirely satisfactory, the time will come when there will be a satisfying therapy, which we may use, of the parathyroids. There are two problems of very great interest to the dentists that have not been mentioned by anybody that I have heard discuss papers here. One is mottling of the teeth, and the other is erosion. Health officers and all other people interested in public health are interested in mottled teeth. Mottling is quite a public health problem, and certainly in the state of Illinois. There are many theories, some of which seem to have been fairly well established, and yet none of these theories have, I believe, been accepted as final. I am going to suggest that in future discussion and consideration of the etiology of mottled teeth, you give attention to the parathyroid as a contributing factor, the water supply and other things perhaps being other factors. It is at least worthy of some consideration and perhaps of some experimentation, as is also this mysterious condition concerning which G. V. Black reported so many years ago, erosion—something to which there is so little parallel in our experience, so little that we can determine by microscopic examination, a mystery, not a matter of great importance, but of some importance, a question that has challenged the thought of dentists for a long time. Isn't it possible that the parathyroid gland that has so much to do with the matter of deposits of lime salts, the proportion between calcium and phosporus in the blood, and the distribution here and there of calcium in the body, may be a factor in the production of erosion? I take it that no public health officer is entirely willing to quit the dental profession until this as a final objective has been obtained: That the teeth should remain in perfect condition to the end of life; that men should come to old age with well preserved teeth. That objective cannot be reached for a long time. We are willing, for the moment at least, to compromise on a second objective, an objective that I as a health man would like to have you assume the burden of, bringing about such conditions by your direct effort, and by educational and other indirect effort; i. e., that the second set of teeth, including the jaws, should be as well alined and the teeth should be as nearly perfect in structure, and should be as resistant to decay as are the first set of teeth. The conditions that affect the deciduous teeth operate largely during prenatal life. The greater part of those agencies have ceased to operate at the time of birth. The question as to whether the first teeth are to be perfect in alinement and in quality has been determined when the baby comes into the world. The rule is that the first set of teeth is perfect, for its purposes, and for the length of time that they remain in the mouth, they are subject to a minimum amount of decay. The mother supplies from her own body the ingredients that are responsible for the perfection of that set of teeth. Society and the dentists and mothers and parents and others are largely responsible for the condition of the second set of teeth. I would offer you as an objective that you see to it that the second set of teeth, for which you are in great measure responsible, is as nearly perfect as the first set of teeth. To begin with, eruption is far less satisfactory in the second set of teeth than in the first set of teeth. Dr. Reese has called our attention to the fact that the thymus gland is a factor in the eruption of the first set of teeth. It begins to atrophy and finally disappears in the midst of the time when the second set of teeth are erupting. How much poor jaw development and poor

quality, comparatively speaking, of the second set of teeth, are the result of the atrophy of this gland, and how much can be remedied by a proper use of the thymus endocrine? We are all greed that a large part of the responsibility for a poor second set of teeth is a lack of proper development in the jaws. I call your attention to what Dr. Reese has to say about the pituitary, the responsibility of the pituitary for the proper development of the bony parts, the possibility that, by proper use of remedies made from the pituitary, we can rectify some part of the failure of development in the jaw.

Dr. Reese (closing): I have practically nothing to add. It is rather far fetched that I as a neuro-psychiatrist should be interested in teeth. My former chief, Prof. Dr. Nonne, in Hamburg had a great deal in dental abnormalities, in nervous and mental disorders. This was more or less an encouragement for me to take it up. In regard to what Dr. Evans has said, I have worked a great deal with parathyroid hormones, especially with McCollum's parathyroid extract. There is no doubt in my mind that one is able to influence definitely calcium metabolism. I do not believe that the endocrine substances should be given orally, because they are less effective than when given subcutaneously, as I prefer with all my endocrine preparations. One word in regard to the standardized solution of irradiated ergosterin: I believe one has to be very careful in using these preparations of viosterol or vicodol, as the University of Indiana calls it, or vigantol, as the Germans call it. An abundance of these ergosterol preparations destroys the vitamin A of the body, because they do not contain vitamin A; they contain an abundance of vitamin D. And you should not substitute cod-liver oil for these preparations, because cod-liver oil has to be added to all irradiated preparations, as it contains five times as much vitamin A as vitamin D. A very effective preparation in our line of work (I do not know whether it has been applied to dentistry) is vitavose, a weak germ extract preparation, containing 78 per cent carbohydrates. It is very active in all the asthenias, perhaps because of its vitamin B_1 and vitamin B_2 content. In regard to vitamin E, I believe that it is similar in its chemical as well as its physical properties to vitamins A and D; there being only a difference in the distribution of E from that of A and of D.

DENTAL LAWS: SUMMARY OF DENTAL LICENSE REQUIREMENTS THROUGHOUT THE WORLD

By ALPHONSO IRWIN, D.D.S., Camden, N. J.

License Requirements That Are Mandatory

1. All dentists, assistant dentists and dental hygienists must be registered in the U. S. A.

2. All dentists, assistant dentists and dental hygienists must be licensed in the United States before they can be registered.

EXAMINATIONS

3. All applicants for a dental license must undergo a practical and theoretical examination. Exception: Accepted reciprocity candidates take a clinical or practical examination only.)

4. All examinations and writings must be in the English language. (Exception: The Spanish language is allowed in the Philippine Islands and Porto Rico.)

5. The applicant for a license must have reached the age of 21 years or over.

PERSONAL CREDENTIALS

6. The candidate for examination must possess a good moral character, certified to by two or more licensed ethical dentists, who must be well acquainted with

the applicant. Under reciprocity, the endorsement of two resident freeholders is required.

PREDENTAL EDUCATION

7. New laws require a four years' course in an accredited high school, or its equivalent; or a certificate from the state supervisor of public instruction; or 15 units or a one year's course (or more) in a state or a recognized university, for matriculation into a dental college, recognized by a dental law; or, as in New York, 72 regents' counts; or as in Pennsylvania, 60 counts, or an equivalent acceptable to the Dental Council of Pennsylvania, and Bureau of Professional Education, of that commonwealth.

PROFESSIONAL TRAINING

A four years' graded dental course in a "recognized dental school" is obligatory in dental laws, except possibly in a few of the oldest acts. (A five years' graded dental course is now a pedagogic regulation established by the Dental Educational Council of America, for Class A and B dental colleges, and dental departments of universities. This regulation is not yet inscribed in the dental acts. The predental education minimum requirements are graduation from a high school; maximum requirements: college diploma from an accredited university or the A. B. degree. A six-year systematically graded dental course is now provided by several universities, with appropriate pedagogic examinations at the end of each course as designated in their catalogs.)

DEGREES

8. State Boards require a dental degree from a "reputable" dental school or recognized college, or dental department of a university, or medical college, countersigned by the secretary, registrar, dean or provost. Class A and B dental college diplomas are specified by some boards of dental examiners.

PHOTOGRAPHS

9. Two recent, unmounted cabinet-sized photographs, countersigned by the applicant, and attested to by the photographer, or a notary public, or the dean or secretary of the college, must accompany the diploma.

APPLICATIONS

10. The candidate must present a properly filled out and attested application, which will be furnished by the secretary of the board on request of the applicant.

CERTIFIED FOREIGN CREDENTIALS

11. All foreign credentials should be validated by the ambassador of the country represented, resident in Washington, D. C.; or endorsed by the consul-general located in New York City and representing the applicant's native land; as rightfully belonging to the possessor thereof, and a certified English translation of the credentials should be supplied to the board of dental examiners.

12. Credentials must be presented to the secretary of the board of dental examiners at least ten days prior to the examination, including all licenses, if any are in possession of the candidate, and preliminary education certificates.

EXAMINATION FEES

13. The examination fee (ranging from $20 to $50, according to the state) should be paid by certified check or post-office money order or cash (which is not returnable, and must accompany the application), prior to the examination. The examination fee does not always include the license certificate. Some dental laws provide for a fee of from $1 to $5 for

the license certificate if issued after the candidate has successfully passed the required examination.

SECRETARY'S NOTICE

14. If credentials are accepted, the candidate will be notified to that effect by the secretary of the board of dental examiners, to whom application is made. The secretary will supply details as to when, where and how the applicant shall appear for examination.

SUBJECTS AND TESTS IN EXAMINATIONS

15. The candidate must present himself at the proper time and place to undergo a practical and theoretical examination before the board of examiners. No excuse will be accepted except that of sickness certified to by a physician. The subjects usually taught and tests applied in a standard "recognized" or an "accredited" dental college are used by dental examiners to demonstrate the qualifications of an applicant for a license. The subjects for examination include: operative and clinical dentistry; prosthetic technic; crown and bridge technic; operative technic; oral hygiene; dental anatomy; orthodontia; oral surgery; physics; biology; or both; chemistry (inorganic, organic, physiologic); metallurgy; technical drawing; anatomy; histology; pathology (general and dental); materia medica; bacteriology; physiology; dental rhetoric; physical diagnosis; anesthesia; radiology; jurisprudence; dental history; ethics; economics.

16. The secretary will forward necessary details in regard to the examinations. If this examination is satisfactory, a license will be issued in due time and signed by the examiners designated in the state dental law. (See Delaware Dental Law 1929.)

REEXAMINATIONS

17. Reexaminations are allowed for those who fail to pass the first examination. A fee, usually of $10, is charged for a third reexamination, or the full fee may be charged for a reexamination.

REGISTRATION

18. (a) All dentists must register in the United States of America with the secretary of the board of dental examiners in the state wherein application is made for a license to practice dentistry.

RECORDING OF CERTIFICATE

(b) A licensed dentist must record his license with the official designated in the dental law of the state wherein the applicant desires to practice dentistry (usually an initial recordation with the county clerk).

REREGISTRATION

(c) A licensed dentist must reregister or renew his license annually with the secretary of the board of dental examiners, in more than thirty states; or according to the provisions for registration in the dental law of the state wherein he practices; and must pay the specified fee therefor. A few states do not require renewal of licenses. Biennial, triennial or quadrennial registration or registration on demand of a board must be complied with in other states.

ASSISTANT DENTISTS

(d) Assistant dentists must be examined, licensed and registered in the United States.

DENTAL HYGIENISTS

19. Dental hygienists must be examined, licensed and registered according to the laws of the state in which they locate, before they can function in any office, clinic, hospital, or dispensary; and must pay the required fees therefor.

20. These requirements constitute the maximum standards established by boards of dental examiners. Any departure from the above-enumerated requirements must be sought from the secretary of the board of dental examiners before whom the candidate wishes to appear for examination.

License Requirements That May or May Not Be Mandatory

STATUS OF DENTAL EDUCATIONAL COUNCIL STANDARDS

1. The standards established by the Dental Educational Council of America and the National Association of Dental Examiners are authoritative and final in the United States. They are accepted by all of the state boards of dental examiners but are not necessarily inscribed in all dental laws.

DIRECT APPLICATION TO SECRETARY OF STATE BOARD

2. In the United States of America, candidates are advised to apply directly to the secretary of the board of dental examiners officiating in the state, territory or island wherein the candidate desires to secure a license to practice dentistry; for application blanks, forms to be filled out and full details to be observed in regard to the examination and manner of procedure. Such application should be made in ample time before the board meetings and the examinations take place.

PRACTICAL TESTS

3. The practical requirements for dentists vary. A few states publish their tests. Many boards announce their tests prior to the examination. A few make them known on the first day of the examination. The boards of dental examiners include the practical tests exacted by the standard dental schools, at their final examinations.

EXAMINATION PERIODS

4. Dental examinations are usually conducted immediately after the dental college commencements, in each state. Some state boards also conduct a fall or winter examination, and a few states have both fall and winter examinations. In a very few states, special examinations may take place after special notices are sent out. The state boards of dental examiners hold examinations the last week in June or the first week in July, except in the territories and island possessions of the United States of America. In a few states, where dental examiners are present at the final college examinations, they may occur in May, or may even take place in some other months. The usual schedule of semi-annual examinations is May and November, June and December (including also the Philippine Islands); August and February in Alaska and Porto Rico; January and July in the Hawaiian Islands.

CHEATING

5. "Cheating in the examination works a forfeiture of all examination and license privileges." Proctors or their substitutes are present at examinations.

PUNITIVE PROVISIONS

6. All dental laws provide for prosecutors and prosecutions, penalties and forfeitures, fines and imprisonments, for the illegal practice of dentistry and infractions of the dental statute. Fines ranging from $25 to $100 for each violation of the law and imprisonment from thirty days to five years and revocation of the license are penalties inflicted.

7. The administration of the law, qualifications for practice, examinations, tests, licensure and registration of den-

tists are statutory mandates. Violation of such mandates make the transgressor liable to prosecution, penalty and punishment, varying in severity and adjusted to the grade of offense committed. On conviction of the illegal practice of dentistry, fines varying from $25 to $1,000 may be imposed; or imprisonment from one to twelve months; or, both fines and imprisonment for each and every offense committed may be inflicted. Revocation of the license, if the offender is already licensed, may be the penalty imposed; while disinfranchisement is liable to accompany gross violations of the civil statutes, especially felony or violation of the criminal code.

Dental Laws: Correlated Information

INTERNATIONAL AND INTERSTATE RECIPROCITY

1. The United States of America does not interchange dental licenses with any foreign country. Interstate exchange of dental licenses may occur. More than twenty of the state boards of dental examiners may interchange licenses by legal enactment. A number of reciprocity agreements exist between contracting boards, but they are subject to cancellation on short notice, which makes this privilege liable to abrupt change. A reciprocity candidate for a dental license must apply directly to the secretary of a state board for the latest information on this subject. The dental hygienist has the reciprocity privilege open to her in more than twelve states. The chief obstacle in the way of establishing reciprocal relations is due to the lack of uniformity in standards of the qualifications demanded of dentists.

ABBREVIATIONS

2. The capital letters A. D. A. stand for American Dental Association; N. A. D. E. is an abbreviation of the National Association of Dental Examiners; N. A. D. F. signifies the National Association of Dental Faculties; D. E. C. of A. means the Dental Educational Council of America.

LITERARY COURSES

3. Several university dental schools may require completion of at least a one year and some require a two or more years literary course in a college, or even an A. B. degree for matriculation. Five or six year dental courses are provided in some university dental departments, with certificates granted pertaining thereto, if the student is successful in passing the final required examinations at the end of each college year. The dental laws do not make such a mandate, unless the dental law specifies a Class A or B dental-college diploma and that college should require such standard for matriculation. This is doubtless taking a step forward toward requiring a literary degree from a state college or university as a condition for matriculation in a dental college requiring a preliminary education of the highest standard. It should be noted that dental laws do not yet legalize a literary college degree as a prerequisite to dental college matriculation; or as a requisite for admission to dental examination.

STANDARDS, PEDAGOGIC AND STATUTORY

These advances in pedagogic standards defer the establishment of uniformity in dental laws. If dental statutes validated the standards advanced by the Dental Educational Council of America, legislators would declare such enactments class-legislation. According to theoretical democratic ideals, this assertion would be endorsed by many of their constituents.

MANDATES: PEDAGOGIC VS. STATUTORY

4. The five years' systematic graded courses of dental instruction formulated by the Dental Educational Council of America, terminating in graduation and the possession of a dental degree from a Class A dental college or department of a university, is mandatory by the aforementioned pedagogic institutions, but it is not yet mandatory in the dental statutes of the United States as a condition demanded for the professional training of a candidate for a license to practice dentistry.

This difference between statutory and pedagogic rules also applies to the degree of A. B. This distinction between statutory and pedagogic examination requirements should be noted. It is required among the rules and regulations for dental examinations by some boards of dental examiners exacting the most stringent qualifications from candidates for a license to practice dentistry. This is in accordance with the authority vested in the examiners by many dental statutes, specifying that the board may exercise their "discretion" in the discharge of the duties legally devolving on them. This distinction between the rules of a board and statutory provisions should also be noted.

METHODS OF OBTAINING PROFICIENCY

5. In a republic, under a democratic form of government, police regulations differ from educational rules in that the laws must provide for all classes of citizens composing its commonwealths; while it is the pedagogic function to train its citizens to higher ideals and standards of living, thinking and professional efficiency. It is to be presumed that dental laws in the United States are legislated accordingly. Legislators have no constitutional right to legislate in behalf of vocational efficiency obtained in one way to the exclusion of vocational efficiency obtained in another way. Vocational efficiency must be recognized by lawmakers, but the best way of obtaining it is not settled by law in a republic. An open mind is the attitude of intelligent legislators in the present stage of professional education in the United States.

LEGISLATIVE TRENDS

6. It is necessary to call the attention of dentists to the fact that dental legislation is in such a reconstructive stage that it is subject to changes more or less sweeping in character and their ultimate effects. The unmistakable trend of present day legislation is toward an advanced standard of preliminary education, longer theoretical training, collegiate and medical education, higher theoretical standards, greater familiarity with correlated sciences and broader professional attainments.

EDUCATORS AS PACEMAKERS FOR LAW-MAKERS

As a logical sequence, as differences of opinion multiply in regard to standards established by educational institutions, so must differences of opinion multiply in regard to making dental laws uniform. Changes in dental laws inevitably follow changes in educational standards. Educators are pacemakers for law-makers. Every law student will find this illustrated in each state of the union.

7. If we look abroad for an illustration, we will find that in Italy, in less than a year, the educational standard changed from the D. D. S. (Doctor of Dental Surgery) standard to the stomatologic, or specialty of medicine, standard, and, as a consequence, two dental laws were enacted within a few months of each other to correspond, stomatology

or odontology taking the place of dentistry in the latest act and supplanting it. Thus the universities set the standard for legislatures.

DEGREES VALIDATED BY LICENSES

8. Foreign dentists, especially those educated in foreign institutions only, should clearly understand also the difference between the final examinations conducted by colleges and the examinations held by a state board of dental examiners. The former examination grants to the successful student a dental degree only, and is conducted by college professors. The dentist must present himself, in the prescribed manner established by a state dental statute, for examination before a board of dental examiners appointed by the governor of such state, and if he is successful in passing the required state board tests after passing the college examination and obtaining his dental degree, he is then licensed to practice in such state only. College examinations are one thing and state board of dental examinations are another. With a possible exception of a few states, no board of dental examiners appointed by a state has anything to do with final collegiate examinations.

FOREIGN DENTISTS IN THE U. S. A.

9. The Dental Educational Council of America confers on the accredited dental colleges of the United States, on application for such right, the privilege of entering in the second or sophomore year alien dentists who are graduates of recognized foreign institutions which train dentists and confer dental degrees after graduation therefrom. In other words, they deduct one year from the established standard courses of dental education required by American dental schools in consideration of a foreign dentist's rightfully possessing a dental degree from a recognized dental college located abroad. If the qualifications and degrees acquired by a foreign dentist possess unusual merit, after graduation from a foreign dental school or department of a recognized university of a higher grade, a credit of two academic years in the prescribed courses of study may be granted by an accredited American dental college. On the completion of the remaining years of study and training and the successful passing of the required collegiate examinations, the alien dentist may be graduated and have conferred on him the degree of D. D. S.

VALIDATION OF DIPLOMAS

The degree of D. D. S. does not permit the foreign dentist to practice dentistry in the United States. He must secure a license from a state board of dental examiners. If such a license is obtained from the board of the state in which the college is located, the diploma is "validated" and possesses a legal significance which it would not otherwise obtain. It permits the possessor to practice dentistry in the state in which it was obtained; and, if the dentist locates abroad, it is a requisite for a license in a foreign country.

APPOINTMENT OF EXAMINERS

In the United States, in the majority of the states, the members of a board of dental examiners are elected by their confrères who are engaged in the active, legal and ethical practice of dentistry, out of their own ranks, and then the required number as specified in the state law are appointed to the board by the governor of each state, to perform the duties of a dental examiner; whereas, in nearly all foreign countries, the examiners are chosen from the dental or medical facul-

ties, or both, or even laymen connected with a college or university are delegated to act as examiners.

AUTHORITY VESTED IN EXAMINERS

11. Dental statutes leave to the discretion of the Board of Dental Examiners the formulation of appropriate rules and regulations and instructions to candidates for a license to practice dentistry. Authority is also vested by law in examiners to exercise their judgment in regard to accepting or granting interchange licenses. If dental examiners are not competent to judge of the needs of their state as well as the value of an applicant's qualifications, no one else is.

12. In a republic, the needs of all classes from the most ignorant and poor to the most cultured and wealthy must be recognized in the laws; while boards of dental examiners as well as legislators must recognize that some provision must be made for dental service in sparsely populated regions, unlike that which must prevail in congested areas and populous commonwealths.

CITIZENSHIP

13. Foreign dentists trained abroad must take out naturalization papers and become citizens according to the laws in some states; but not in all of them. New dental laws are making citizenship a prerequisite to the eligibility of a foreign candidate for a dental license.

MODIFICATION OR NULLIFICATION OF LAWS

14. State dental laws as usually published may be nullified or superseded, modified, added to or supplemented or its provisions repealed by underlying laws, such as dental or medical acts antedating them, or by naturalization laws, narcotic acts, income tax laws, by transportation laws or one of the 657,892 laws estimated to be inscribed on the statute books of the United States.

INTERNATIONAL AND INTERSTATE DENTAL RECIPROCITY

15. It is necessary to repeat the fact that the United States of America does not interchange dental licenses with any foreign country. Reciprocal relations negotiated between any state board of dental examiners of the United States of America, and any corresponding board of any foreign country in consequence would be null and void; for reciprocal relations must be established by the national government at Washington, D. C., by treaties of reciprocity with such foreign government before such reciprocal relations may be established between any state of the union and any foreign government. If such reciprocal relations are consummated in the future by the federal government, details in regard to this action must be obtained from the Department of State, Washington, D. C., before any such agreements are consummated. This applies especially to the twenty Latin-American republics, as well as other countries abroad. The fact that such a state of affairs exists is direct evidence of a lack of uniformity in the dental laws of states in the past. There is an approximation to uniformity of laws in certain groups of states whose standard of education is acceptable, and the uniformity of their requirements is the basis upon which state interchange of license may be made possible. Whenever dental laws lack uniformity, stabilized reciprocity is impossible.

SELECTING TEETH FOR FULL DENTURES*

By GEORGE WOOD CLAPP, D.D.S., New York City

NATURE gives to every face some characteristic which dominates the expression. She may apply it in many ways. One of the most striking and most easily recognizable characteristics is the outline form of the face, seen full front, while in repose.

It may be that, in a heroic moment, she hews that face in flat or concave surfaces and merely rounds the lines where those surfaces meet, as in Figure 1, left, or, in a gentler hour, she rounds it all in curves, as in Figure 1, right, with not a flat or concave surface to be seen.

Sometimes, she makes it long in proportion to its width, as in Figure 2, left, or short in proportion to that width, as in Figure 2, right, the important point here being not the actual length or width but the relation of length to width.

The characteristics by which Nature dominates a face should be a law unto the dentist who is to retain the expression peculiar to that face or to try to restore it or improve it by means of artificial dentures. The dentist who wishes to live up to his opportunities in such a case is not a free agent. He must train himself to recognize the elements of form which are dominant in that face, to know how to find similar elements of form in artificial teeth and to bring harmonious face forms and tooth forms together with only such modifications as he considers will improve the appearance.

*Read before the Section on Full Dentures at the Midwinter Clinic of the Chicago Dental Society, Jan. 14, 1930.

As one looks casually at the numberless faces that cross the field of vision, the form characteristics seem to be so intermingled that no amount of skill in analysis can so separate them as to make any classification possible. But quite the contrary is the case. If the principles are once understood, separation is easy.

More than a century ago, artists engaged in painting portraits discovered that all faces can be divided into three great groups. In 1911, George H. Wilson published, in his "Manual of Dental Prosthetics," the diagram shown as Figure 3, which was originally presented more than a century ago by Madame Schimmelpennick.

These forms, in modern faces, are shown in Figure 4: left, the square; center, the tapering, and right, the ovoid.

FAILURES IN DENTURE SERVICE

In the early years of this century, J. Leon Williams, an American dentist then living in England, who had won distinction as a painter, was familiar with this classification of face forms by artists and had used it extensively in drawing and painting.

He had often been struck by the fact that when he was called on to place dentures in edentulous mouths, something incongruous was introduced into the expression whenever the patient exposed the teeth, and that no effort of his in such cases could prevent the destruction of what might have been, up to that moment, a pleasing expression.

Feeling that the cause of the incongruity, with the resulting unpleasing appearance, lay in some violation of an artistic principle by the teeth, he spent some years seeking the law of harmony of face form and tooth form, but was unable to find it, because, in those days, the principle of temperamental forms in

Fig. 1.—Two faces with very unlike form characteristics. The face on the left exhibits straight lines and concave surfaces, while that on the right shows curved lines and convex surfaces.

Fig. 2.—Faces showing different relations of facial lengths and facial widths. The face on the left is but little wider at the zygomatic arch than the face on the right, but it is long in proportion to its width, while the other is short in proportion to its width.

faces and teeth was dominant and was incapable of constructive or satisfactory application.

DR. BERRY'S METHOD

About 1907, F. H. Berry of Milwaukee proposed a sound principle for selecting tooth forms to harmonize with any face form. It was that the upper central incisor, when inverted, should be like the outline form of the face, as is shown by the outline drawn on the face in Figure 5.

I began to use and teach this method as soon as it was announced, but immediately encountered serious difficulty, not with Berry's principle, which stands today

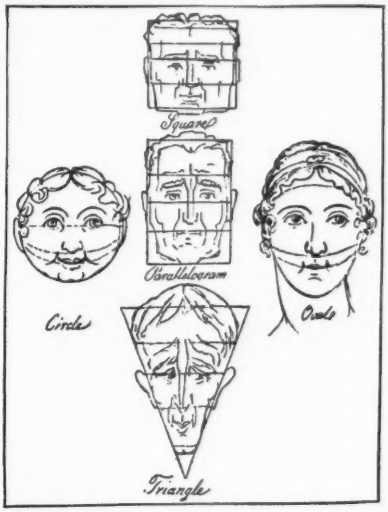

Fig. 3.—Diagram of the typal face forms published more than a century ago by Madame Schimmelpennick. (Reproduced from Wilson's "Manual of Dental Prosthetics.")

stronger than ever, but from the fact that there were, in those days, few artificial upper central incisors which conformed at all well to face forms, and when they did, the conformation was occasional and accidental, not the result of knowledge and design.

It may be worth while, for the sake of those dentists whose memories of den-

tal practice do not go back more than ten or fifteen years, to say that, prior to 1914, practically all the artificial anterior teeth available to dentists had deteriorated into a few conventional modifications of what we now know as the tapering form. Perhaps 75 per cent of the artificial teeth used by dentists were in the six molds shown in Figure 6.

It is true that some other teeth were narrow and some wide, that some were long and some short, but they had lost most of the characteristics which would satisfy a man like Williams or which

Fig. 4.—Faces corresponding in principle to the diagram in Figure 3. The illustration does not show the ovoid face form well here, but this face is wider below the level of the condyles than at the condyles, and all the surfaces are rounding.

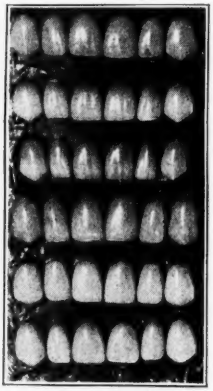

Fig. 6.—Six molds in which 75 per cent of the anterior teeth used in this country at the beginning of the century were cast. The anterior tooth forms generally available had, at that time, deteriorated into conventional forms, which were applicable to very few patients.

Fig. 5.—Outline drawn on face showing the portion of the face with which the outline of the upper central incisor should be as nearly identical as practicable. F. H. Berry published this method in 1906 or 1907, but it was of no great practical value until J. Leon Williams made it so by giving us tooth forms like face forms.

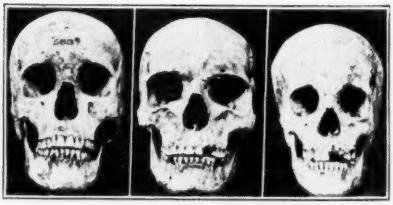

Fig. 7.—Three typal forms shown in three ancient Egyptian skulls, perhaps from the time of the pyramids. In 1914, J. Leon Williams startled the dental world by announcing that there were no such things as temperamental forms of anterior teeth, but that there were three typal forms (shown herewith) by combinations of which all other forms were produced.

made it possible for anybody to carry out fully Berry's principle of selection.

BERRY'S PRINCIPLE MADE WORKABLE BY DR. WILLIAMS

It is not necessary to repeat here the story of how, at the end of more than ten years of patient search and partly through his use of material sent him by H. E. Friesell, Dr. Williams discovered, in 1911, the principle which had so long baffled him. It was that, in natural teeth, there are three fundamental forms, just as there are three fundamental forms in faces, and that these basic forms in teeth are like the basic forms in faces, square, tapering and ovoid.

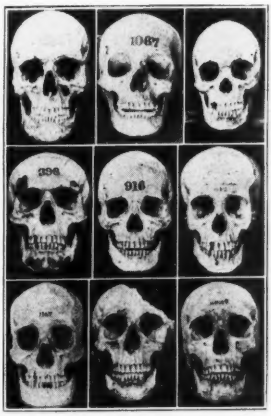

Fig. 8.—Nine skulls assembled by Dr. Williams from widely separated localities (and perhaps 5,000 years apart in history) to prove that these three typal forms were characteristic of skulls from all parts of the world of which sufficient data were available to make a decision possible. They all have the same form of teeth, the square.

Fig. 9.—Skulls of anthropoid apes, showing the typal forms in natural upper central incisors even more strikingly than is shown in man.

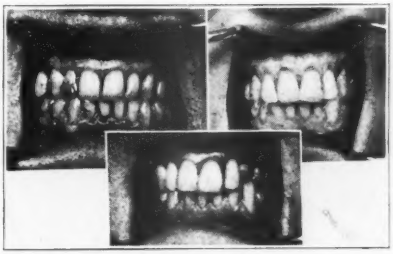

Fig. 10.—Three sets of natural teeth in young people of today, showing the same types of teeth as in the ancient Egyptian skulls and the anthropoid apes.

With the incorporation of this discovery into the forms of artificial teeth, Berry's principle not only became workable, but also opened up new possibilities of achievement to denture workers.

Fig. 11.—Typal forms of face, perhaps more frequently found among races living under rather primitive conditions than in highly civilized races. The figure in the center is not well enough posed to enable us to judge the face form, but the ovoid and tapering forms are well shown in the two other faces.

EVIDENCE OF THE WORLD-WIDE SPREAD OF TYPAL FORMS

It will suffice to refresh your memory if there are here reproduced a few illustrations on this point. Figure 7 shows these three typal forms of teeth very clearly in Egyptian skulls which may have been animate when the Pyramids were built.

Figure 8 shows nine skulls from nearly all over the known world and from historical periods which may be 5,000 years apart, all with teeth of the square type. These typal forms in teeth appear to have arisen spontaneously all over the world, because there was, in olden times, only limited intercommunication among these places.

Figure 9 is offered in support of the belief that this classification of tooth forms is biologically sound, for it shows the three typal forms in the anthropoid apes, who may have branched off from the development stem long prior to the branching off of the human race.

Fig. 12.—Picture taken by Dr. Boots on a bear hunt in Korea. The faces are not posed well enough to permit exact definition, but they can be seen to be rugged typal forms, and one or two of them at least are tapering.

Fig. 13.—Labrador Eskimos showing the typal square faces, at right and left, with a somewhat tapering face in the center. (Courtesy of Dr. Waugh.)

Fig. 14.—Alaskan Eskimo with a typical ovoid face. (Courtesy of Dr. Waugh.)

PRESENTATION OF WILLIAMS' PRINCIPLE

Williams' principle of the three fundamental forms did not find immediate acceptance among dentists. It had been my privilege to introduce, some years before, an acceptable improvement in the occlusal forms of bicuspids and molars, and the possibility of improvement in the

Fig. 15.—Three Japanese faces, showing the square, tapering and ovoid types.

anterior teeth had naturally drawn Dr. Williams and me together, so that, for some years prior to his epoch-making discovery, we had been working in close cooperation. Many of the presentations

Fig. 16.—Face shown (left) of the square type. A photograph of the patient's natural upper central incisor was inverted and superimposed on the photograph of the face. The shadow over the face on the right shows with what fidelity the tooth outline in this case follows the facial outline and proportions.

Fig. 17.—Face (left) of the tapering type. A photograph of the patient's upper central incisor was inverted and superimposed on a photograph of her face. The shadow on the picture on the right shows how closely the tooth outline follows the facial outline.

of his discovery to the dentists whom he considered to be the leaders in prosthetic

Fig. 18.—Face (left) of the ovoid type. A photograph of the patient's upper central incisor was inverted and appears in the shadow on the face on the right. It does not follow the facial outline so closely as did the teeth in the other two cases (Figs. 16-17), but it is shown to be sufficiently close for all practical purposes. In judging the fidelity of this tooth outline to the facial outline, it is necessary to disregard double chins and the like.

Fig. 19.—Face (left) of the generally square type. In learning to classify face forms, one must learn to look for the important characteristics and to disregard those that are unimportant. In the drawing on the right, the artist shows what students should look for while learning to classify faces: the nearly straight cheek lines converging but slowly downward, the flat plane of the cheeks and the broad plane across the face, including the high and wide forehead.

work at that time occurred in my office, and I had the joy of being present at, I believe, every important interview. Not one of those to whom he presented his information uttered a word to indicate that any inkling of the discovery had ever dawned on him. Some of them were convinced by the evidence which Williams was able to present, even at that early date, and they willingly accepted the discovery as pointing a way out of the chaos of face forms and tooth forms in which we were all then engulfed. Others, more cautious, withheld decision until time and further reflection enabled them to form a decision unlikely to be changed.

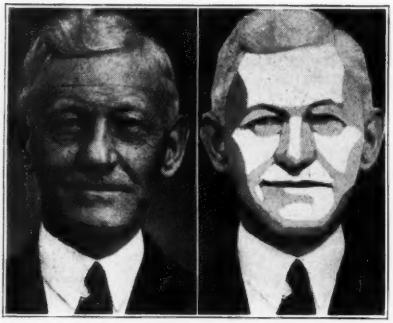

Fig. 20.—Face (left) nearly typal tapering. In the drawing on the right, the artist has outlined the planes which give its type. The cheeks converge more rapidly downward than in the square type, and the planes are apt to be hollow. The sides of the head converge forward more rapidly than in the square type, and the forehead is likely to be narrower.

Fig. 21.—Ovoid face (left). The drawing on the right shows that there are neither straight lines nor flat surfaces, but that all the planes are bounded by curves.

Fig. 22.—Left: Typal square face. Right: Face in which the severity of the typal square form has been softened by an intermixture of some of the ovoid. Combinations of two types into a single blended form are perhaps more numerous and usually more pleasing than the merely typal forms.

Fig. 23.—Left: Face typal tapering in form. Right: Face tapering with an intermixture of the ovoid, which gives a softer and pleasanter outline.

It will suffice to close this part of the paper by submitting, in Figure 10, illustrations of these three typal forms of teeth from fine natural dentures of people now living: above, left, the square; right, the tapering, and below, the ovoid.

SIMPLIFYING THE SELECTION OF TOOTH FORMS

Let us now turn from the story, which has so far been largely historical, to the practical application of Dr. Williams' discovery, which is, as yet, far too little understood and too indifferently applied to enable us, as denture prosthetists, to take our rightful place in public esteem, and to assure the welfare of many of our patients, and let us see if we cannot so simplify the principles of face form and tooth form and the harmony between them that when we leave this room, we shall find the task of securing pleasing effects with artificial dentures easier than ever before.

Fig. 24.—One of the most frequently seen forms of face in this country, especially among people engaged in intellectual pursuits and as business executives, a combination of the square and the tapering, perhaps with the tapering slightly dominant.

It is something of a disappointment to many of us to learn that the knowledge that there are three typal forms of face does not at once enable us to classify most of the face forms we see. Perhaps this disappointment may be partly explained away by the thought that the typal forms probably occur more frequently in aboriginal races than in those highly civilized, just as they are still frequently seen among races that live under what we call primitive conditions. On a tour with Professor Gysi around the United States in 1928, we saw many typal faces among the Indians in New Mexico (Figure 11). Dr. Boots finds them among the Koreans, as shown in Figure 12, and Dr. Waugh has shown us the typal face forms among the Eskimos of Labrador and Alaska (Figures 13 and 14).

It is not surprising that, as travel became common and unlike races and types intermarried more than had before been possible, other forms of face should have become numerous because of the crossing and recrossing in every conceivable manner of the typal forms. Nor can it be doubted that, as civilization softens the rigors of existence, some of the harsher forms appear less frequently and other softer forms more frequently. It thus comes about that composite forms resulting from the blending of the typal forms are more numerous than the typal forms, and that, to our eyes, accustomed perhaps more than those of any other race to the results from the advances of civilization, the composite and softer forms are more pleasing and beautiful than the severe typal forms.

A FEW SIMPLE PRINCIPLES

In summing up what we have studied, we need to keep in mind only two or three simple principles:

1. That every face form, other than a typal form, results from some blending of two or more of the typal forms.

2. That face forms composed of two types blended together are more numerous in this country than severe typal forms.

3. That two typal forms are rarely present in a face in exactly equal proportions, but that one type is usually dominant and gives to that face its characteristic expression.

If Nature has designed similar typal forms in faces and teeth—square, tapering and ovoid—we ought to find square teeth in square faces, tapering teeth in

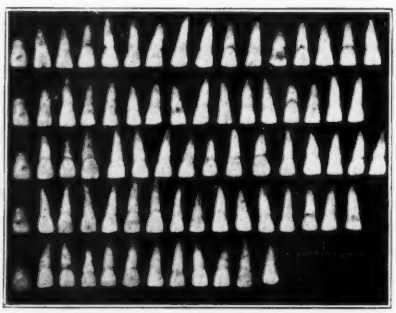

Fig. 25.—Five modifications of the typal tapering tooth form of upper central incisor, each modification in a row. Some of them are pleasing, but many are not. Many which are fairly pleasing in natural teeth would not be satisfactory in artificial teeth. Artificial teeth which represent the best modifications for each row are to be seen at the left. Nature makes a great many modifications of each typal form in teeth, some of which are pleasing and some of which are not pleasing.

tapering faces and ovoid teeth in ovoid faces.

In the natural dentitions which are most pleasing when critically examined, we find that identity of form to an extent that is surprising when the endless intermixture of races and types is considered. Of course, there are a much greater number of faces in which the face and teeth are not of just the same outline form, but the discrepancy is not great and the natural dentition is pleasing.

Only in the relatively small percentage of cases in which there is a marked difference of form between face and teeth is the dentition unpleasing, when critically examined, because of tooth form.

HARMONY IN FACE FORMS AND TOOTH FORMS

Let us see this identity of face form and tooth form in a few of those people whose natural dentitions, on critical examination, are pleasing. If, in such cases, a photograph of the upper central incisor

Fig. 26.—Left: Natural teeth (from the practice of J. P. Ruyl) taken some years before the dentition had been destroyed by wandering of the teeth. Right: Arrangement of artificial teeth which nearly duplicated the arrangement of the natural teeth at their most pleasing period.

is enlarged to be as wide as the face and is superimposed, inverted, on a photograph of the face, it is seen that the outline of the tooth follows with surprising accuracy the outline of the face, observed full front in repose, minor irregularities in facial outline being disregarded. The length of the teeth, with astonishing constancy, is equal to the length of the face from the margin of the chin to a point about two-thirds the distance from the eye-brows to the normal location of the hair line (Figs. 16-18).

Having established the existence of typal forms in modern faces and teeth and the identity of face forms and tooth forms in the most pleasing dentitions, let us examine the characteristics of the typal forms so that we may be able to recognize their elements when we see them in combination in either faces or teeth.

Figure 19 shows, at the left, a square face as it is usually seen and, at the right, the same face as an artist might draw it in the planes, which really give most of its expression.

It will be seen that the principal plane of the cheeks, just below the zygomatic arch, is flat and almost vertical, so that this and the similar plane of the opposite cheek are nearly parallel. Another way of saying this is that the sides of the face from above the ears to the angles of the jaw are nearly straight and nearly parallel.

Figure 20 illustrates the typal tapering face in the same way. Note that the cheek planes are much less vertical and parallel than in the square type, so that they converge noticeably downward, inward and forward. The planes of the sides of the face above the zygomatic arches are well defined and converge forward more rapidly than in the square type. It is a distinguishing characteristic of the most severely typal tapering faces that the surfaces here represented as planes are noticeably concave. The extent to which Nature has carried out identity of form in faces and teeth is shown by the fact that the labial surfaces of the most strongly typal tapering teeth are distinctly concave from side to side.

The typal ovoid face cannot be drawn in the nearly flat planes which so often distinguish the square face or in the concave surfaces which mark the most typal tapering faces; but in Figure 21 the artist has done what he could to identify for us the sections of spheres by which such a face is bounded.

Two characteristics of this ovoid form, other than its general roundness, deserve attention. The first is that the face is wider below the zygomatic arches than it is above them. This is the reverse of the other two types, which are narrower below the zygomatic arches than above. The second is that the chin in the ovoid form is often more delicately modeled than in either of the other types. When you see a beautiful chin, suspect the presence of at least some of the ovoid type.

Let us look at a few combinations of the types as seen in faces and identify the elements. In addition to the typal forms, we need to recognize only three things: (1) a combination of the ovoid with the square, as shown in Figure 22; (2) a combination of the ovoid with the tapering, as in Figure 23, by which the severity of the square or of the tapering forms is modified without their characteristics being lost, and (3) a combination of the square and tapering types, with perhaps the tapering a little dominant, as shown in Figure 24. Many years of observation have satisfied me that this form of face is very common among American executives and those engaged in intellectual pursuits, and when we are to make full dentures for such people, the query as to whether or not the face is of this form should be one of our first thoughts.

It remains now only for us to determine whether or not characteristics similar to those which we have seen in faces exist in artificial teeth and, if such characteristics are there present, to learn to use them.

Figure 25 shows a collection of natural teeth, all of the tapering type. It will be seen that there are many forms, and that some of them would not be suitable for reproduction in porcelain. Arranged in

a vertical column on the left are some porcelain teeth of the tapering type. A little study of the forms of the natural teeth will show that the porcelain teeth present very well the fundamental characteristics of the most pleasing among the natural teeth. This shows how a relatively few scientifically designed forms of teeth may be made to supply a great number of needs.

The practical application of this information begins with an obvious fact. There are innumerable combinations of the typal forms in both faces and teeth. No one who practiced in the "pre-Williams" days wants innumerable unrelated forms in artificial teeth back again, because selection among them would be impracticable. And so Dr. Williams interrupted what might be called the "flow of form combinations" at points just far enough apart to give to each form of face a readily discernible distinction, and he gave us tooth forms suitable for these and readily capable of modification for other forms.

If we keep in mind that Berry's plan that the form of the upper central incisor should be like the form of the face was biologically and artistically sound, and that Dr. Williams made it workable for the first time, it is evident that all we need to do is to have before us a mold guide of correctly formed anterior teeth, to invert the upper central incisors and to select that form which looks most like the face in outline and general contour. Such selection will be made more rapid, more profitable and, I believe, more enjoyable if the dentist will master and apply the simple principles which have been given here.

J. P. Ruyl, one of the most successful prosthetists in the United States, has so mastered the principles of face form and tooth form that he classifies the face form as he meets the patient in the reception room or as she is ushered to the chair. It then remains only to choose the most desirable mold from among two or three of the type. He does this with his chair nurse inspecting the teeth from one side while he views them from the other. This method easily and quickly scores for him a high degree of success.

When the desired form of tooth has been selected, the choice can be confirmed by arranging the six anterior teeth from the mold guide on a selection rim and trying them under the lip. This affords a fine opportunity for imparting a little information to the patient.

VINCENT'S INFECTION: SMEARING AND STAINING TECHNIC

By FRANCIS H. DALEY, D.M.D., Boston, Mass.

THE first essential in making a correct microscopic diagnosis of any disease is a properly stained section or smear of the lesions involved. The method of smearing must be such that we obtain a true picture of the condition as it exists in the lesion. As far as possible, we must avoid contamination with débris and bacterial flora. Such contamination tends to obscure or confuse the diagnosis. In making a microscopic examination in Vincent's infection, this is most important, because, in the average case, there are many contaminating factors.

We have found that the most practical method of smearing is with a small platinum loop. We do not advise the swab method because of its superficial scope and its attendant dilution with bacteria and débris. The platinum loop can be sterilized thoroughly before and after using. Constant sterilization does not impair its efficiency. The smear is freshly made. Its use allows us to penetrate deeply enough into the lesions that we obtain a picture of the actual condition as far as bacterial invasion is concerned. If a small loop is used, the operator can, by gentle manipulation, work it well into the lesion, without great discomfort to the patient and with a minimum of hemorrhage.

Many different types of stains can be used for the microscopic diagnosis of Vincent's infection. For the purpose of bringing out certain characteristics of the organisms, we may use the more complex methods, such as the iron hematoxylin. Some men use the Gram method. In our work, we have confined ourselves to the use of two: methyl violet and methylene blue. For the most part, we use the methyl violet, aqueous solution, 2 per cent. It can be applied cold, does not take long to penetrate and is washed off in cold water. We use the blue stain where we wish to bring out the characteristics of the borrelia to a more marked degree.

Our technic of smearing and staining depends on exact attention to details. The operator washes his hands thoroughly. The use of rubber gloves is optional; the operator may use bichlorid of mercury if he so desires. The operator then sprays out the entire mouth, giving special attention to the interproximal spaces. For retracting the cheek, we use aseptic wooden throat sticks. These sticks can be burned, and we have avoided the use of an instrument which might, through carelessness, be used again on another patient. This initial spraying cleanses the surface and washes out a great deal of débris. Care must be taken not to use enough pressure to cause any hemorrhage. The platinum loop is now held in the open bunsen flame until it is a cherry red. The slide which has been immersed in alcohol is dried and ready. The loop is held in the hand until it has cooled

sufficiently to be used. It is never laid down because of the possibility of contamination. With the cheek retracted by means of the throat stick, the loop is inserted into the suspected area and gently pushed as far as possible toward the base of the lesion. Enough material will usually adhere that a second attempt is unnecessary. As many areas as are desired may be taken in this way, the operator merely flaming the loop between smears. The material is streaked in a thin, even film over the slide. If the smears are made vertically, it is possible to get from eight to ten different areas from the same mouth on the same slide. The material must be smeared evenly in order that the finished section shall not be too thick or too thin for diagnostic purposes. When this process has been completed, the loop is again flamed before it is set down. The slide is now quickly passed through the bunsen flame three or four times in order to "fix" the smear upon the slide. The slide must not be heated to such an extent that the organisms are "cooked."

The slide is now ready for the application of the stain. The aqueous solution of methyl violet, 2 per cent, is applied over the smear, cold. It is left on for from about forty-five seconds to one minute and then washed off in clear, cold running water. After a thorough washing, the slide is dried by blotting between sheets of Japanese bibulous paper. A small drop of oil is applied to the smear, and it is ready for the microscope.

The advantages of this method can readily be seen: It is easily carried out; it is fast, and it is accurate, if the operator has been attentive to detail. The time involved from start to finish is a matter of from but three to five minutes.

The oil immersion microscope is used for diagnostic purposes. The lens is focused directly into the oil. This will give us the same index of refraction from the smear to the eye. If the ordinary high power lens is used, there will be a lower degree of magnification because of the space interposed between the smear and the lens. This gap gives a different index of refraction.

In taking the smear, we emphasize the fact that the operator must take every precaution against infecting himself. We have seen several cases in which infection of the operator has occurred.

ADDRESSES OF THE SURGEONS GENERAL*

I

By Merritt W. Ireland, M.D.,
Surgeon General of the Army

YEAR by year, we find the professions of medicine and dentistry becoming more closely allied. From the standpoint of health conservation, they now meet on common ground. Jointly, they are constantly attacking and successfully solving various problems in preventive medicine. In the Army today, no physical or clinical survey is considered complete without a careful dento-oral examination on the part of the dental officer. Contrast, if you will, the modern trend with the conditions prevailing in the Regular Army not so very long ago.

The practice of dentistry began to flourish in this country as early as the Revolution. Your first society was formed, your first dental periodical published and your first dental college established nearly a century ago; yet it was not until after the Spanish-American war, still fresh in the memory of many here assembled, that the military authorities recognized dentistry as a necessity rather than a luxury. Prior to that era such dentistry as was practiced in the Army was carried out on the apprenticeship basis, the medical officer or the hospital steward being required to possess some knowledge of the fundamentals of extraction and the application of temporary fillings. If a member of the Army required expert dental service, as he frequently did, he was forced to seek it outside, at his own expense.

The Spanish-American War brought prominently to the fore the need for a corps of dental surgeons in the Army, but nothing in the way of relief was done until 1901, when legislation was enacted providing for the employment, as a part of the Army, of thirty dental surgeons, under contract.

Ten years later, or in 1911, there was authorized a dental corps to consist of one dental officer, on a commissioned status, for each thousand men in the Army. The advent of the World War found this allowance insufficient, and the President, under the war powers conferred on him by Congress, authorized an increase in the dental corps which provided one dental officer for each 500 of the total strength of the Army.

After the World War, and as an incident of demobilization, the Dental Corps again reverted to the legislative authorization of one dental officer per thousand of Army strength. There it remains today. In spite of many handicaps, the Dental Corps of the Regular Army is keeping abreast of the the times and rendering signally constructive service. In addition to its strictly professional work, it is conducting the Army Dental School at the Army Medical Center here for the postgraduate instruction of its members in the military phases of dentistry, and for the training of enlisted specialists in dental mechanics and dental hygiene. Officers of the Dental Corps

*Read at the Second General Meeting of the Seventy-First Annual Session of the American Dental Association, Washington, D. C., Oct. 8, 1929.

serve on the faculty of the Medical Field Service School at Carlisle Barracks, Pennsylvania, and also attend that school as students for courses of instruction in field work.

In our daily work, we are encountering too many cases of infection directly attributable to dental foci. This is due to the large number of recruits entering the service with these foci already developed, to the comparatively rapid turnover of enlisted personnel and to the fact that there is an inadequate number of dental officers to cope with the work which ought to be done.

Too much time of the members of the Dental Corps is being taken up with the treatment of dental caries and gingivitis and their end results to the treatment of effect rather than cause. With a larger dental personnel, we would be able to concentrate on the prophylactic measures so essential.

Our aim is to have an organization sufficient to conduct an annual dental survey, and then, by instituting prophylaxis at least once a year, to keep within reasonable bounds the great toll now being exacted by the two primary dental affections just mentioned.

At our larger clinical centers, we wish to adhere to the principle of group medicine now universally recognized. Up to a few years ago, dentistry as a specialty of medicine was given little if any credit in the maintenance of health. Today, we clearly recognize that very many diseases which ultimately lead to chronic invalidism are primarily due to dental foci of infection. Accordingly, the dental practitioner is now an active member of the clinical family and is working hand in hand with his medical brother in nipping disease in the bud.

In all our hospitals and dispensaries, the dental clinic is being utilized routinely in the examination of patients and in locating the cause of obscure affections. This means a tremendous amount of intensive and time-consuming work. If the Army is to conduct a satisfactory dental service among our military personnel and safeguard them against disabilities which are preventable, we must have dental officers in sufficient numbers. Instead of having one dental officer per thousand of Army strength, we need almost twice the number now authorized.

I have already recommended the enactment of legislation to that end. The Army at large appreciates the value of the Dental Corps and is extending a helping hand in bringing this much needed increase to the attention of Congress.

I also want to see the Dental Corps receive the recognition its work so justly deserves. In our war plans, provision has already been made for the grade of general officer for members of the dental corps. But war may be, and let us hope is, only a remote possibility.

Therefore, I have further recommended that the grade of Brigadier General in the Medical Department of the Regular Army be authorized in time of peace for the member of the Dental Corps who serves as Chief of the Dental Division in the Surgeon General's Office. That officer not only represents the Army Dental Corps—he is the spokesman of the civilian dental profession of the country in all matters relating to dentomilitary preparedness.

Such a measure would reflect the appreciative sentiment of the Army in its efforts to recognize fittingly a progressive and influential profession, a profession that is whole-heartedly laboring with the medical fraternity in mitigating the ills to which the flesh is heir.

II†

By Charles E. Riggs, M.D.,
Surgeon General of the Navy

The personnel of the Medical Department of the Navy consists of four branches — the Medical Corps, Dental Corps, Nurse Corps and Hospital Corps. Its activities extend all over the world, and the distribution of its personnel is consequently world wide. We are charged with the health and medical care of not only the Navy but also many thousand war veterans, and of the native populations of numerous island possessions and certain countries to whom we are bound by treaties. This means that our people are carrying on not only in the naval hospitals and other naval shore establishments in this country, but also aboard ships operating in the seven seas, with the marines on expeditionary duty in China, Nicaragua—wherever they happen to go —and in these islands: West Indies, Hawaiian Islands, Guam, East Indies and down across the equator to Samoa.

Although the Dental Corps of the Navy was established as recently as 1912, and had only thirty members at that time, it has since so grown in size and in the scope of its activities that it is today an organization that we can look upon with well warranted pride. Last year, the strength of the Dental Corps was increased to 174 officers. One of my first recommendations on assuming my present office a few months ago was that this strength be increased to 186 officers. The approval of this recommendation by the Secretary of the Navy has been, of course, very gratifying. I, however, am not satisfied with the present legal allowance of dental officers, and it is my hope that new legislation will permit an increased Dental Corps complement which will make available to the personnel of all ships, and of all shore stations, an adequate and complete dental service. It is my belief that the primary function of the Medical Department, which is to maintain the highest possible order of physical fitness, is seriously hampered in this purpose wherever the attendant dental service is inadequate in any way.

The rapid advances being made in dental science and methods of treatment have made necessary, as well as highly desirable, the maintaining of a Naval Dental School here in Washington. This school gives each year two five and one-half months' courses in special postgraduate work and is attended by as many dental officers as the demands of the Service will permit. It also gives courses for Hospital Corpsmen, in which they receive training in the duties of dental technician and dental assistant. In addition to the educational activities of the school, it conducts a clinic where, each year, dental service of all kinds is given to several thousand persons among the naval personnel and World War veterans. The sittings were almost doubled during the past year, owing largely to a more complete cooperation with medical officers in attempting to eliminate foci of infection and assist in the more speedy recovery of hospitalized patients. The facilities of the school are such that the District of Columbia Dental Society made use of the establishment this year for the clinical part of its annual meeting, which was attended by about 250 local dentists.

It is impossible in the time at my disposal to tell you about the system of organization, administration and policies of the Dental Department, but I want to mention a few recent developments in

†In the absence of Surgeon General Riggs, his address was read by Paul G. White, official representative of the Dental Corps in the Bureau of Medicine and Surgery.

this connection. We are now endeavoring to effect a concentration of dental officers at training stations and recruit depots sufficient to render newcomers to the Service dentally fit prior to transfer to sea duty. This is being done with the idea that it will serve toward reducing to a minimum the later separation of personnel from duties of importance, and will thus result in an economic advantage accruing to the Government.

During the past year, prosthetic dental laboratories were established at three more naval hospitals and aboard the hospital ship, U.S.S. *Relief*. There are now twelve such laboratories in operation at the various naval hospitals. Affairs of the Dental department are administered by the Dental Division of the Bureau of Medicine and Surgery. Two dental officers are detailed to this work. The functioning of this division has added immeasurably to the morale of the Dental Corps, in that technical problems are dealt with by officers who have an understanding of the difficulties, situations and conditions which may affect the efficiency of the dental service, and who are best able to recommend ways of meeting these problems. This division strives constantly to bring about better coordination, with the result that there is now a very desirable degree of systematization and improvement in the methods of providing dental treatment; and the volume of dental service afforded the personnel has been made to approach the maximum with the number of dental officers available.

I wonder if many of you are aware of the remarkable account our Medical Department people gave of themselves during the late War. I wish to mention a few unadorned facts in this connection, with special reference to the dental officers. This will give you an idea of the extent to which military hazards and military distinctions may come to an arm of the Service that does not perform strictly combat duties. There were 331 members of the Naval Medical Department personnel on the scene of actual engagements in the World War. Of these, 176 were killed, wounded or gassed, a casualty ratio of 53 per cent.

The Congressional Medal of Honor is the highest military distinction conferred by the United States Government. Of twelve such medals awarded to the entire naval personnel, six went to members of the Medical Department — two medical officers, two dental officers and two hospital corpsmen. The Naval Medical, Dental and Hospital Corps personnel won also during the great conflict: seventy-five Navy Crosses, forty-six Distinguished Service Crosses, 237 citations and letters of commendation, 114 French Croix de Guerre, three Italian Croci di Guerra and two Portugese Cruzes da Guerra.

It should interest you to know that the first officer of the Navy to meet death in overseas engagements was Weeden E. Osborne, Lieutenant, Dental Corps, U. S. Navy. In addition to the posthumous awarding of the Distinguished Service Cross and the Medal of Honor, the Navy has named a destroyer, the U.S.S. *Osborne,* in honor of the extraordinary heroism this young dental officer displaced while under fire.

Of late, there has been a great deal written and said on the subject of medical ethics. The principles involved quite naturally apply as well to the ethics of the dental profession.

Dentistry is a humane profession, with purposes and ideals that act with great force as emotional bonds uniting your members. The dental and medical professions are likewise bound to each other by their common purpose of promoting

health and relieving human suffering. In a few plain words, our system of ethics requires that we deal with our patients and with each other with motives and with manners that are honorable and just.

That the dental profession is observing and enforcing an increasingly high standard of ethics, I have no doubt. As evidence of this, one need only note the marked decrease during recent years of the number of highly commercialized and flagrantly advertised dental parlors—establishments which made false claims; claims which made them false to their patients and unfair in their method of competition against the honorable members of the profession.

The contribution that dentistry has made to public health is indeed a great one. It is now universally accepted that one of the most essential features of the periodic health examination is the dental part of the examination. We have become deeply impressed with this fact in the Navy, and the dental examination is now a regular part of the annual physical examination taken by every officer of the Navy. Needless to say, these examinations are supplemented by the corrective measures that are indicated at the time.

Thorough, sympathetic cooperation between the dental surgeon and his medical confrère is necessary if dental disease is to be considered adequately in relation to the health of the patient, and if all data relative to the patient's condition are to be evaluated properly. Dental diagnosis is thus not merely a consideration of local symptoms; it is, in a large sense, the application to the case at hand of the sum total of the knowledge and diagnostic skill of all individuals concerned with the patient's physical welfare.

In contemplating the future of dentistry, there can be no cause for apprehension. The present trend is indicative of finer ideals, higher standards of education, the performance of an increasing volume of valuable research. Such trends offer the strongest possible assurance that our hopes for the future of dentistry will be fulfilled.

III

By Hugh S. Cumming, M.D., Surgeon General of the Public Health Service

Speaking from a public health angle, it may be fairly said that, half a century ago, no amount of foresight or intelligence in the matter of public health could have secured the public at that time the benefit of dental prophylaxis and treatment. This, of course, is because of factors that go to make up modern dentistry which had not been developed nor coordinated, and if one had attempted a general prophylaxis, there was not a sufficient body of men of knowledge to carry it out.

The greatest stride in your specialty of medicine, as I see it, was made when the emphasis was definitely shifted from mere repair and relief work to preventive dentistry and oral prophylaxis, just as the great shift has been made in other branches of medicine. Even at the present time, I venture to say, your specialty is not fully prepared to play the part demanded of it for the health needs of the people. But this is now a matter of mere lack of numbers, and not of ability or knowledge, as before.

In the past twenty years, the number of dentists has more than doubled, I understand, but, even now, many more, of course, would be required if a wholesale program such as we are advocating should be adopted. You have definitely taken your proper place in public health. This has nowhere been better indicated than in the public health service. Even here,

we suffer from an insufficient number of dentists to carry out much needed work, even among the beneficiaries of the Government service.

It is fortunate that the education of dentists has now been placed on so high a plane that it deserves to be considered among the other specialties of medicine, and this is especially fortunate now, I think, since you very frequently have the first opportunity for detecting such abnormalities as are manifested by general disease in the field of your observation.

I believe it is very generally the custom of the dentist to refer such cases to the proper medical specialist for treatment. The exact relation of the teeth, the gums, etc., and causation of disease has not yet been scientifically determined as a whole. Beyond the obvious menace of the pus pocket at the roots of teeth and the diseases caused by caries, we have, as yet, I believe, no great numbers of actual data on which we can rely; but it is very significant that many of the communicable diseases are contracted in the air passages. It is fair to speculate, perhaps, that if these air passages could be kept at all times in a healthy condition, their resistance to disease germs might thereby be increased, and the total bulk of the diseases in which we are peculiarly interested as public health advocates be reduced.

It is more and more recognized that public health work has need of men in your specialty as much as it has of the other medical men and sanitary engineers, and that able and progressive members of the dental profession should be employed on health work in every state, every city and every county. A dental examination should always be an essential part of any adequate school health program. I do not believe that the underlying reason for caries and pyorrhea has been determined with any scientific accuracy. It seems to me that we should have more research on these problems. It would be one of the most profitable lines in public health. Our service has not been so active in taking up these subjects, but it is evident that only a well-planned, coordinated, amply supported and probably long-continued series of research would suffice to give us the desired answers to these questions. As more light is provided on the cause of these conditions, we shall be in a better position to advise rational methods of prevention, and then perhaps for the first time the dental profession will be confronted with a situation that has already been accepted by the medical profession as a whole, namely, to be called upon by its own effort to diminish its own business. I trust that this fact will not deter any young men from entering the profession, because there are not a sufficient number of dentists at present.

I should like to make a plea to the dental profession for not only the continuation, but also the expansion and intensification of its interest in the broader significance of its work, that is, the relation of its peculiar work to the general health of the individual, and to the broader questions of public health which concern the profession most intimately.

RESIDUAL INFECTION*

By JOHN OPPIE McCALL, D.D.S., New York City

THE subject of residual infection is of importance to the periodontist largely from the standpoint of his usual interest in the oral diagnosis or, let us say, in the diagnosis of focal infection. Circumstances frequently bring it to pass that the periodontist is called on as a diagnostician in many cases which are not perhaps primarily periodontal disease, and it is therefore necessary that the periodontist be equipped to give an opinion on various matters which may lie just outside the field of periodontology in its narrower sense. Any case in which there is a metastatic disease requires, of course, the most complete diagnosis as to possible foci of infection.

One of the problems which has presented itself to me with an increasing emphasis on its importance and also its difficulties has been that of residual infection. It is a part of oral pathology which has been sadly neglected, and yet it is quite as important from the standpoint of diagnosis and of the consequent procedures to be invoked as is the matter of periodontoclasia or periapical disease, or any of the other manifestations of infection in the mouth which tend to produce metastatic results. It is a subject which has been neglected by both the pathologist and the roentgenologist. That may seem a rather sweeping statement, but I hope to justify it in the course of my presentation.

In the past, the investigation of residual infection has been made, if at all, by the bacteriologic method, a method which is not beset with insuperable obstacles, but which, nevertheless, presents some difficulties. However, there will be many cases in which bacteriologic investigation may be unsatisfactory.

For instance, I compare this with the bacteriologic examination of periapical infection in which we have had in the past so many conflicting statements and conflicting reports. I believe that the ideal method of examination is a combination of the bacteriologic and the histologic, i. e., the use of both methods on the same case. But in this particular series which I have been carrying on, our effort has been simply to establish what histologic facts were to be found without direct reference to the possible bacteriologic findings in those cases. The next step will be naturally to carry on both types of examination, each type on the same case.

The histologic method also offers difficulties. In operating on living patients, we are seldom justified in excising the amount of tissue which the histologist would like to have all in one block for the examination. That is to say, we have to consider the fact that the patient is expected to live after the operation, and, consequently, we cannot mutilate the jaws to an extent that would prejudice the future comfort if not the health of the patient. Hence, we have to be content with removing rather small masses

*Read before the American Academy of Periodontology, Washington, D. C., Oct. 4, 1929.

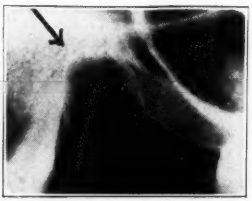

Fig. 1.—Upper right first bicuspid region. The sharply defined area of marked radiolucence indicates the presence of a cyst.

Fig. 2.—Portion of tissue removed from area shown in Figure 1. *A*, cyst membrane. (×80.)

of tissue whose loss will not, later on, deform the surface contours very much. The ideal procedure would be to take a section through the jaw bone, starting with the oral mucosa on the alveolar ridge, and carry it down or up, as the case might be, to a region which would correspond to the apical region of the tooth which formerly occupied that position. This, of course, cannot be done on the living patient.

The term residual infection applies to infections which have remained after the extraction of teeth. In all such areas of infection, teeth once were present, and the tissues became infected previous to or at the time of tooth extraction, the infection persisting there for an indefinite time.

We find, in examining these areas, that the specimens of tissue that we feel may be removed without prejudice to the patient's after-comfort tend to show two types of involvement. In one type, we have the presence of epithelium, which was in the site, of course, before the tooth was extracted. This type tends to develop into a cyst just as epithelium at the root end of an infected tooth under influ-

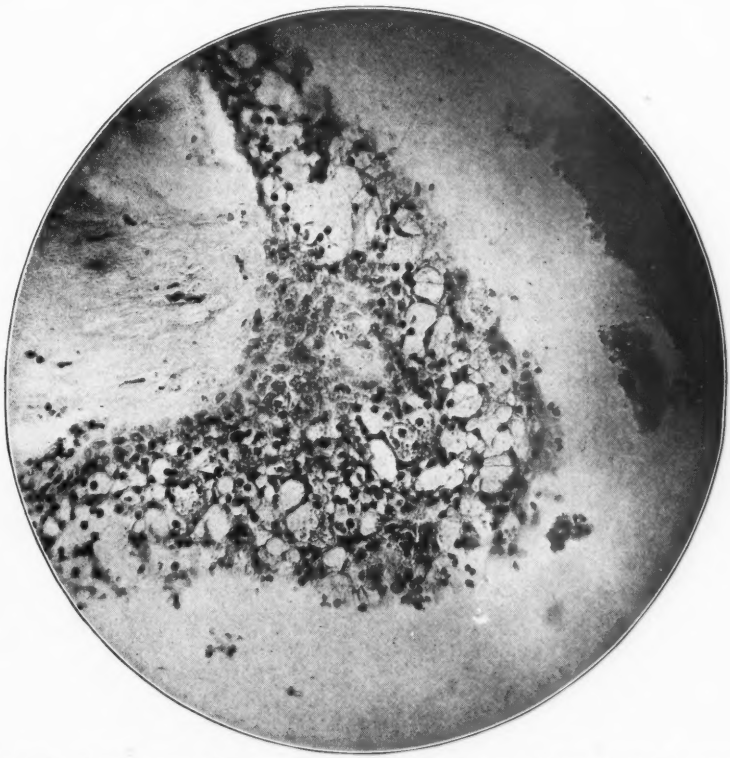

Fig. 3.—Portion of cystic membrane shown in Figure 2. Round-cell infiltration is present. (×200.)

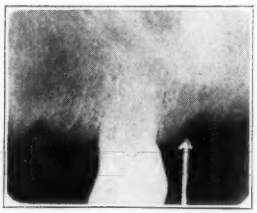

Fig. 4.—Upper right molar region. There is a semilunar depression in the alveolar border in the second molar region. The mucosa over this area was normal in contour and color and free from tenderness.

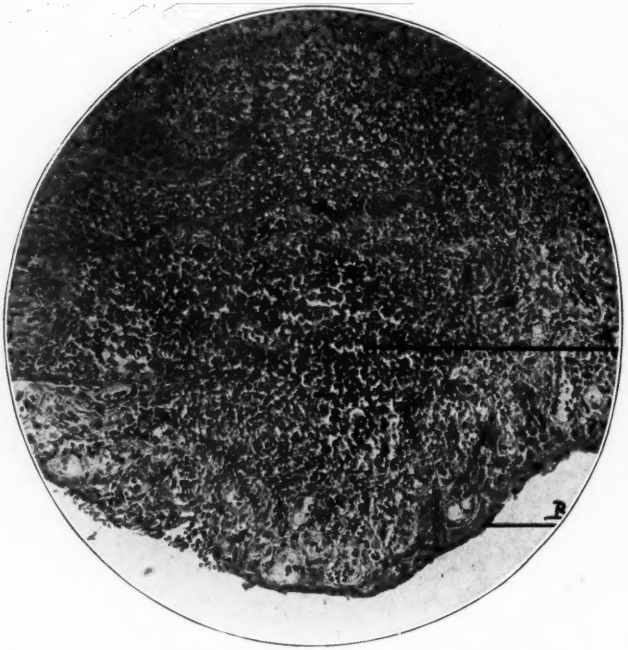

Fig. 5.—Tissue removed from area indicated in Figure 4. *A*, profuse cellular infiltration; *B*, epithelium. (×150.)

ence of bacterial activities tends to become a cyst.

The other type does not show any epithelium and consequently does not develop into a cyst. Its diagnosis by the roentgen rays is much more difficult. In the latter class of case, of which most of the specimens consist, we find two kinds of tissue reaction. One is the commonly found expression of inflammatory change which consists of the presence in the tissue of more or less large masses of cells, chiefly blood cells of various types, lymphocytes and plasm cells, with few, if any, polymorphonuclear leukocytes.

The other kind of tissue reaction is that in which we find no increase of cells in the part, except that there may be a proliferation of the tissue cells themselves. Here, we have a fibrosis. That is a change which is not ordinarily interpreted in pathology as distinctly inflammatory, but the study of these specimens will, I believe, indicate that the two types

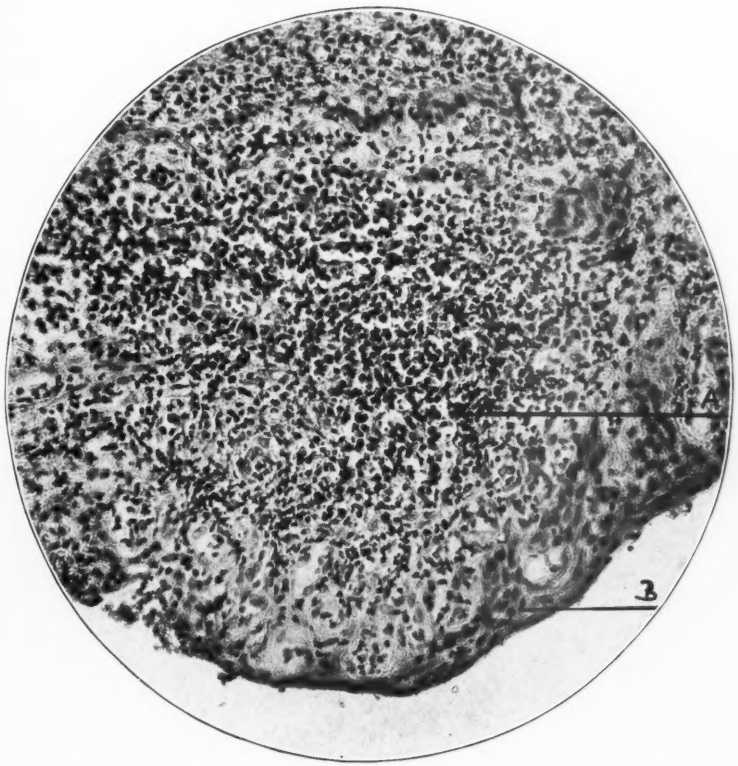

Fig. 6.—Tissue shown in Figure 5. *A*, mononuclear and polymorphonuclear leukocytes; *B*, epithelium. (×250.)

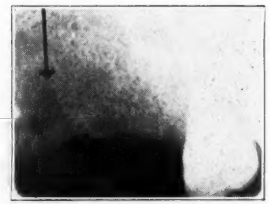

Fig. 7.—Upper right bicuspid region. There is a generalized diffuse radiolucence.

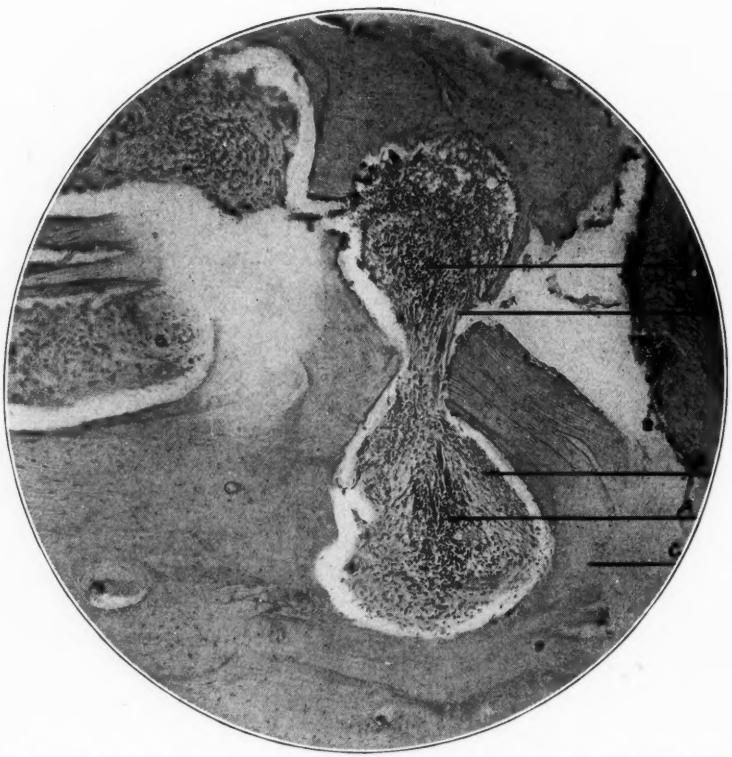

Fig. 8.—Bone removed from area indicated in Figure 7. *A*, cellular infiltration; *B*, fibrosis; *C*, bone. (×80.)

of tissue reaction go on more or less side by side and each one is an expression of an inflammatory reaction.

By way of presenting a hypothesis which will explain the mild character of these reactions in many of the cases, I would call attention to the fact that the tissues themselves, as examined by ordinary methods of inspection, do not show inflammatory conditions. The overlying mucosa is pink and dense, firm and healthy in appearance. There is no pain, no tenderness to pressure and, in the average case, very seldom any symptom which would indicate to the patient or to the dentist who merely makes a mouth examination that there is anything wrong in that particular part of the jaw.

This is probably to be accounted for by the fact that *Streptococcus viridans,* when it becomes located in the deeper tissues, does not tend to produce violent reactions. At least, many of the strains do not, and, consequently, we have comparatively mild tissue reactions to that infection as contrasted with the violent reactions which usually take place when the invasion is by the staphylococcus or some of the other more actively pyogenic organisms.

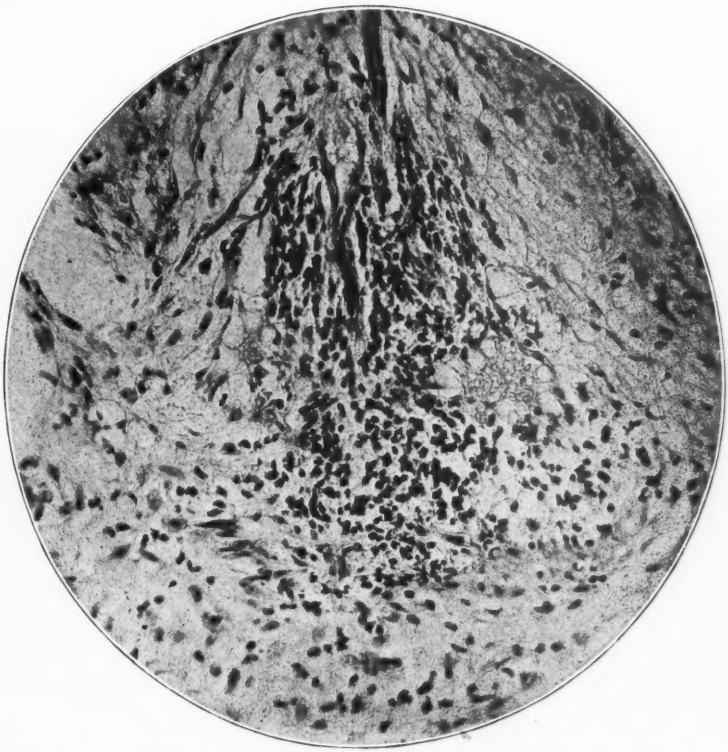

Fig. 9.—Bone shown in Figure 8. There is cellular infiltration present. (×300.)

We find many gradations of reaction in these tissues, and a very striking thing which I am not able to point out so well in the photographs as in the original specimens: the fact that bone deposition may and very frequently does occur and seems to be going on more or less continuously in the presence of infection, in an inflammatory process.

tion, but we also unquestionably have a certain amount of bone deposition, and it is a matter of great importance to keep in mind the fact that infections do not by the mere presence of infecting organisms inhibit the deposition of bone. The deposition of bone, then, as indicated in the roentgen-rays, does not guarantee to us that the particular region in which

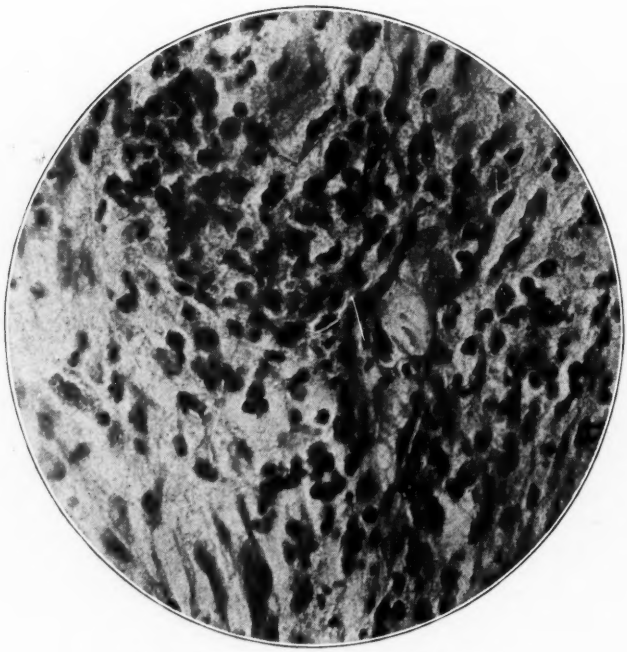

Fig. 10.—Bone shown in Figure 9. (×600.)

We know that bone deposition can go on at the end of an infected pulpless tooth. We find that expressed in the roentgen-rays in terms of bone condensation, increased density to the rays. The same thing, to a varying degree, takes place sometimes in residual infections. We undoubtedly have some bone destruc-

that deposition is going on is free from infection.

SUMMARY

The subject of residual infection is an extremely important one. An important point in diagnosis is this, that, in many of these cases, the tissue which in the roentgen rays would seem liable to show the

most profound inflammation showed really very mild reaction or no apparent reaction at all, and, on the other hand, cases in which the roentgen rays revealed comparatively slight variation from the normal frequently showed the most severe forms of inflammation when examined under the microscope. This indicates that we must, in making diagnoses for focal infection cases, and, for that matter, in the case of healthy people who might later develop focal infection, examine with just as great care the portion of the roentgenogram which covers edentulous areas as we give to that in which teeth are still in place.

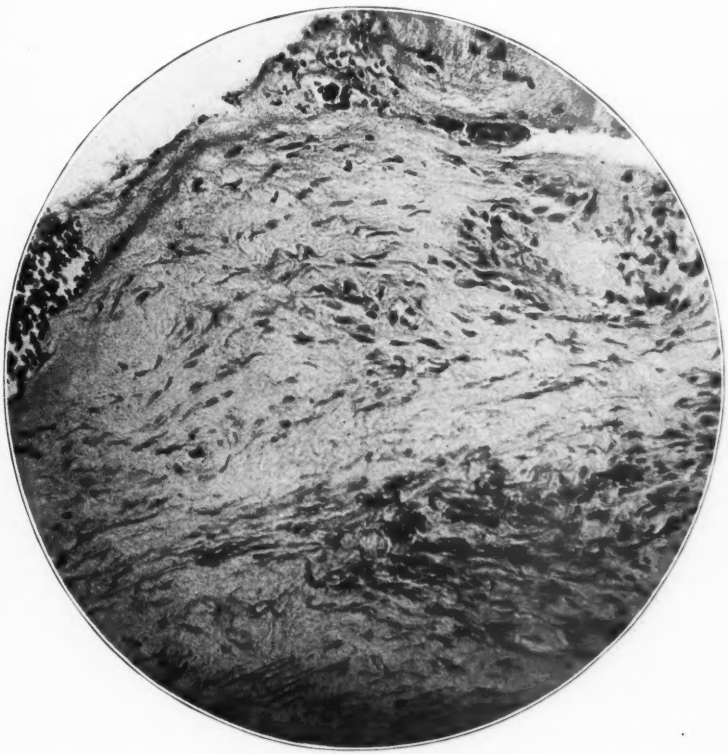

Fig. 11.—Bone shown in Figure 8. There is fibrosis present. (×300.)

DISCUSSION

Arthur H. Merritt, New York City: One of Dr. McCall's slides showed an area after the extraction of an impacted third molar. It was probable, though he did not give the history of it, that that was not a case of periapical infection, but what was it? If he found a residual infection, from what did it proceed? Was there originally a periapical infection or was there, as is often the case under such circumstances, merely a periodontal infection? Another question I should like to ask concerns the statement

Fig. 12.—Upper right bicuspid region. There is a small semilunar elevation on the alveolar border. The bone above it exhibits slight radiolucence.

Fig. 13.—Tissue removed from area indicated in Figure 12. *A*, areas of cellular infiltration; *B*, areas of fibrosis. (×80.)

regarding the filling in of bone, which so frequently happens where we have had periapical infection. All of us have seen the radiolucent areas at the apices of teeth which, although very marked and well defined, were completely obliterated by the filling in of new bone, owing to effective root canal therapy. If that new bone is not indicative of a healthy reaction in the tissue, what caused its development? We know that if it had not developed, that radiolucent area would have remained indefinitely. Something happened there that brought about a condition which appears to be healthy even if it is not. What did happen, and what may we, as clinicians, expect? I should also like to have Dr. McCall make clearer, if he can, how one is to make a differential diagnosis. I observe that he, with his large experience, found areas that appeared to be infected, but were healthy. How are we, who are less well informed, to make these diagnoses? Also, I should like to know what he did in the way of bacteriologic examinations of these cases. Those that he showed us had to do with the histologic rather than the bacteriologic findings. If these are residual infections, what was the nature of what he found there and what was the after-result of the treatment of these cases? If these patients having a focal infection metastasis came under the care of the surgeon, did they recover as a result of these operations? I observe that in most of these cases, the patients appeared to

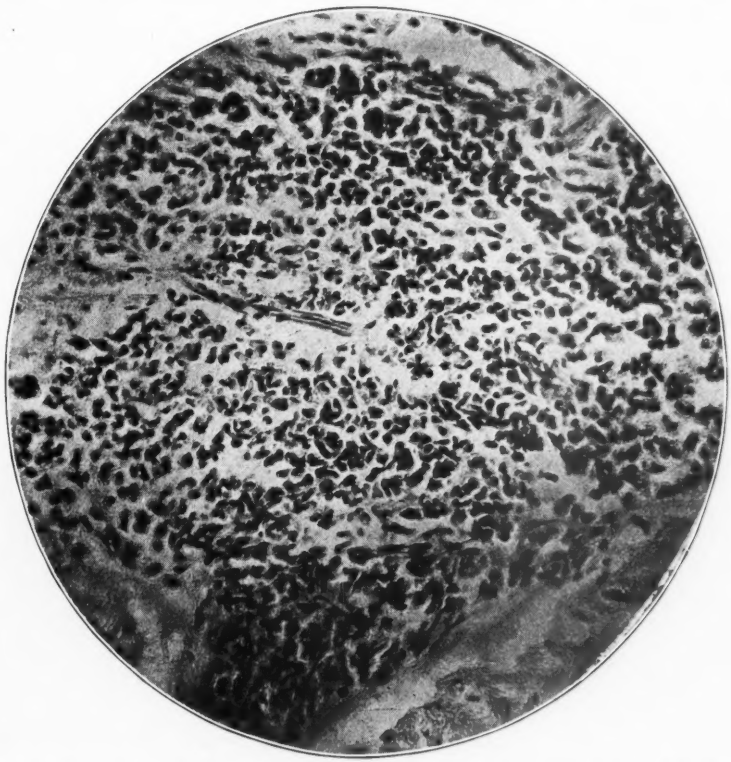

Fig. 14.—Tissue shown in Figure 13. Mononuclear and polymorphonuclear leukocytes are in evidence. (×300.)

have been operated on not long after extraction, a year or perhaps more. I wish to raise a question as to whether the condition which was found there may not have been due to the fact that not sufficient time had been given for a more healthy condition to develop. In other words, was it not a sort of transitory condition that was found?

Wilhelmina Yeretsky, Grand Rapids, Mich.: Did Dr. McCall make the statement that it is possible to have a residual streptococcic infection within the bone and have no external tissue reaction?

cells of the myeloplastic type, which have nothing to do with inflammation but are just a type of bone-marrow cells so close to the alveolar margin that we had to be very careful to have control material from the other side of the jaw. One could easily mistake them for the meroblastic type of cells, which have to do with bone formation or formation of new blood cells brought together by a foramen extraction occurring a long time ago and now no longer residual.

F. L. Adams, Tampa, Fla.: Have these cases been followed farther to determine

Fig. 15.—Tissue shown in Figure 13. There is fibrosis present and the wall of the blood vessel is thickened. (×300.)

Rudolf Kronfeld, Chicago, Ill.: I have seen many bone marrow specimens taken from human jaws, and in the marrow, close to the alveolar margin, there are little foci of crowded cells which it is difficult to identify. We have tried to make differential diagnoses. Dr. Orban, especially, tried to determine what the cell was, and he observed, at least in a few cases, a sharp distinction between

what the roentgenographic examination revealed? I should like to ask Dr. McCall, also, whether it is possible, after five or six years, for the apex of a root broken off to be surrounded by an area of rarefaction and still appear to be of the same density as bone.

Donald F. Mosher, Kansas City, Mo.: Even if occasionally we find that some of

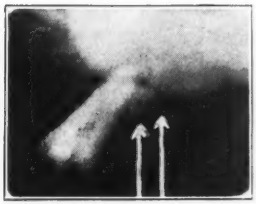

Fig. 16.—Upper right molar region. There is an area of bone condensation distally from the molar root, with rarefaction still farther distally.

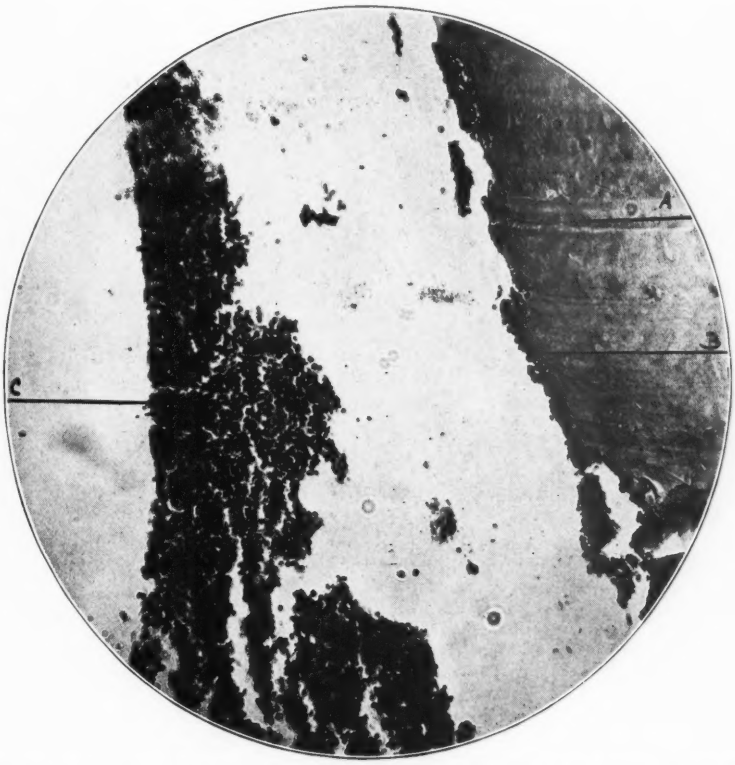

Fig. 17.—Bone removed from area indicated in Figure 16. There is heavy cellular infiltration on the left. This tissue pulled away from the bone during preparation of the specimen. Osteoclastic activity is present along the border of the bone. *A*, bone; *B*, osteoclasts; *C*, leukocytes. (×150.)

these areas are not infected, there are enough of them infected to lead us to give the patient the benefit of the doubt. In my own practice, a week never passes that I do not have at least one area opened up. In a former association, we did culture these areas with the Rosenau technic, and the results were that most of them were found to be infected. Some of the worst looking cases, as Dr. McCall mentioned, were found not to be infected, while others that looked very well were found badly infected. As a matter of health protection to the patient, therefore, I open all these areas. I always tell the patient that I am not sure that there is infection in this area but I feel that they cannot afford to take chances with it. It does not involve the removal of bridgework, teeth or anything else, and is simply a matter of a small fee and a little discomfort.

Dr. McCall (closing): Dr. Merritt asked about the condition of the third molar in the slide shown. This was not a periapical infection. The third molar was not carious. It was completely impacted, that is, it was not visible in the mouth. In the original roentgenogram, the condition which I found was characteristic of so many of these impacted or partially impacted third molars, especially in the mandible; that is, a rarefaction shown at the distal aspect of the crown of the impacted tooth indicating a zone which is wider than that normally seen around the crown of a tooth in the course of eruption.

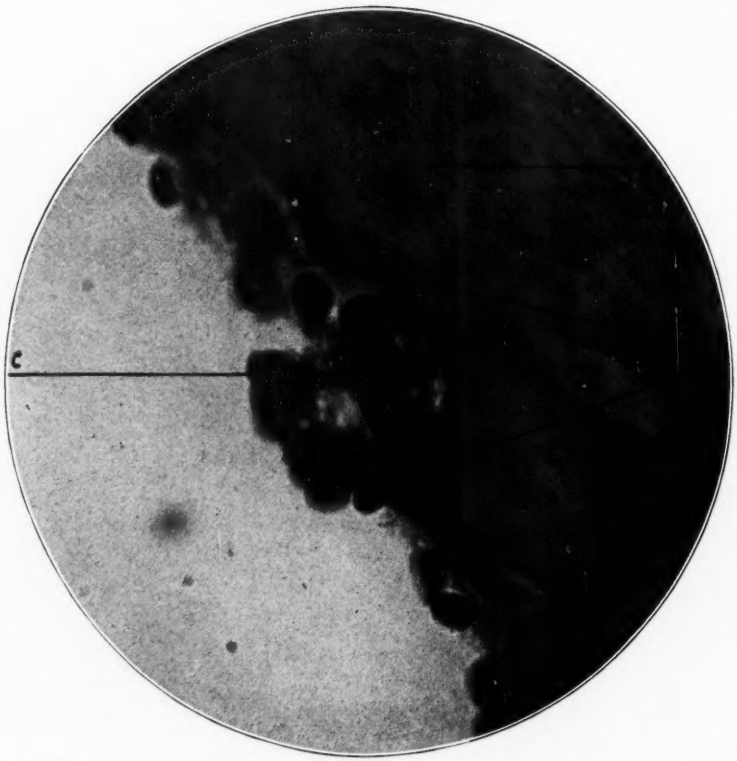

Fig. 18.—Bone shown in Figure 17. The osteoclasts in Howship's lacunae are to be noted. *A*, bone; *B*, lacunae resorption; *C*, osteoclasts. (×1,300.)

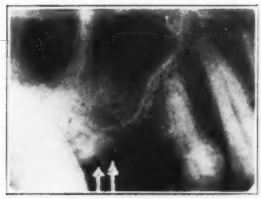

Fig. 19.—Upper left first molar region. There is bone condensation mesially from the molar, with rarefaction still farther mesially.

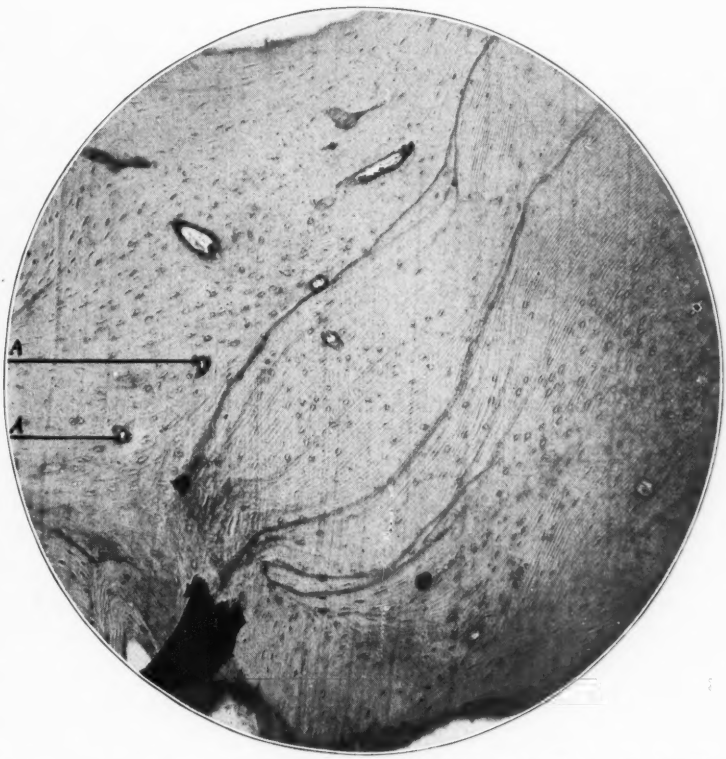

Fig. 20.—Bone removed from area of condensation indicated in Figure 19. Scarcity and reduced size of marrow spaces are to be noted. *A*, condensing osteitis. (×80.)

That sac, we might call it a "sac follicle," is plainly visible in the roentgenograms of erupting teeth, and the third molar will show it also, but, in these cases, the zone becomes abnormally wide on the side toward the distal aspect, and my interpretation of that has been that there was an infection which we

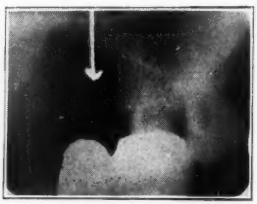

Fig. 21.—Upper right second bicuspid area. The tentative diagnosis of residual infection was not confirmed by the histologic findings.

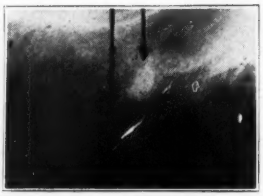

Fig. 22.—Upper right second bicuspid region. There is rarefaction near the border with condensation higher up. The histologic finding was marked infiltration indicating residual infection.

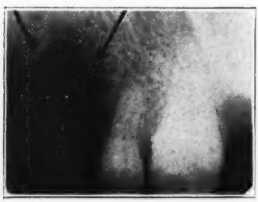

Fig. 23.—Upper right cuspid region. There is a marked generalized rarefaction. The histologic finding was marked infiltration indicating residual infection.

have called a pericoronal infection, that is, an infection around the crown of the tooth. My explantaion as how this occurs is that the advancing third molar produces pressure, or at least an abnormal contact with the second molar in its eruptive tendency, and that because of some disturbance which is thus induced on the distal aspect of the second molar, bacteria penetrate into the follicle of the third molar, infecting the space. Of course, it is not a space altogether because the tissue is connected with the enamel, but there is a soft tissue there which

Fig. 24.—Region between upper central incisors. There is rarefaction present. Diagnosis: probable enlargement of anterior palatine foramen. Histologic examination, conducted because of large size and position of the area, disclosed no inflammatory reaction.

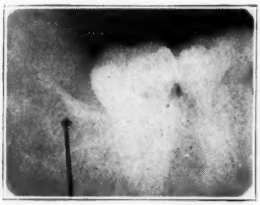

Fig. 25.—Lower left third molar region. Outline of the socket of a previously impacted molar is to be noted.

is capable of being invaded by micro-organisms. They do not penetrate, apparently, as far as the roentgen ray will show, at least around the root of the third molar, but the crown area seems to be quite often seriously involved. I have seen many cases in which I have felt convinced that these third molar infections did actually involve more of the

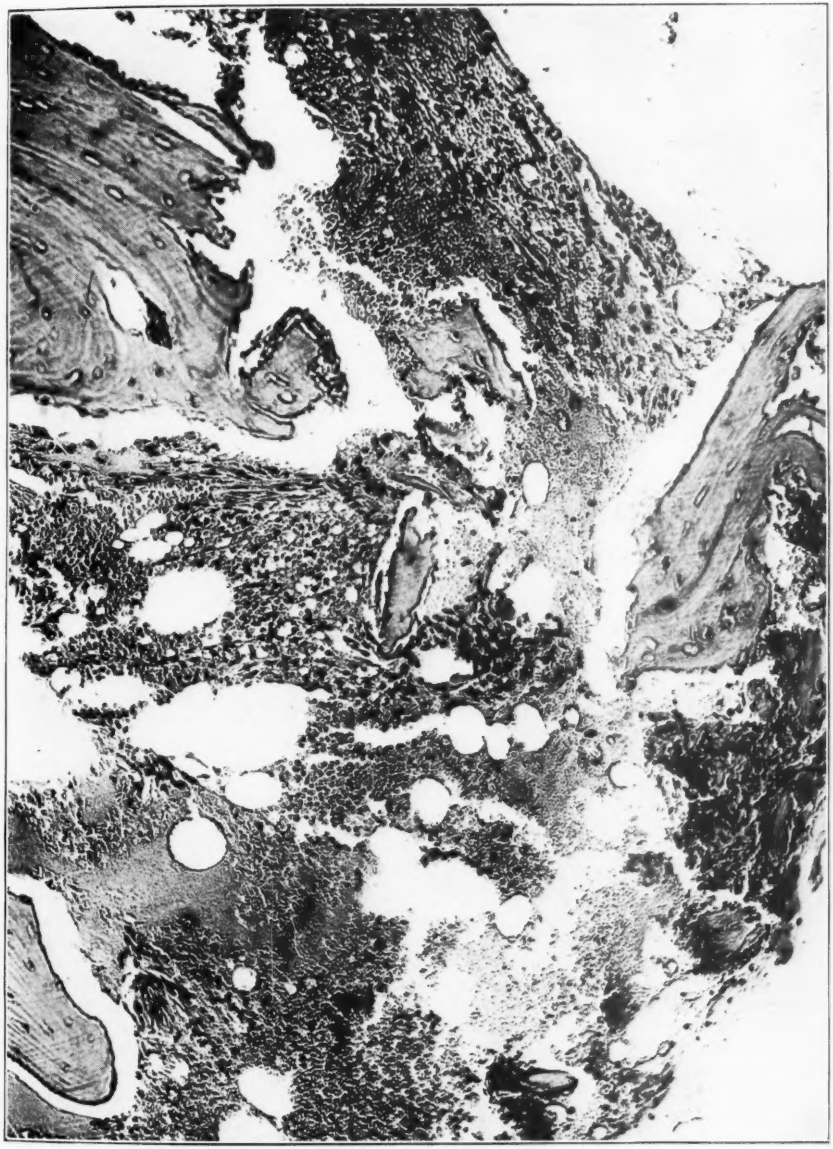

Fig. 26.—Tissue removed from area shown in Fig. 25. There are bone fragments and cellular infiltration present. A pure culture of Staphylococcus albus was obtained at operation.

bone, but I have not seen it in the roentgenogram. After the teeth are removed, it is a fairly common experience, especially if the cases have not been given good drainage and surgical attention after the extraction, to have these areas show rarefaction, and in many of them, I have advised curettage, with benefits to the general health; which brings me to another of Dr. Merritt's questions, having to do with the results of operations. This is a difficult question to answer specifically because, in many of these cases, the mouth of the patient has shown other pathologic conditions as well as that in the particular area which I have been interested in, and when we remove a tooth showing periapical infection and then curet bone from one of the residual areas, and the patient makes an improvement, we do not know which one of the two things was the more important, or whether one was more important than the other. I do not believe that I can recall,

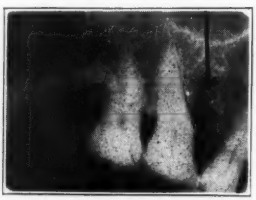

Fig. 27.—Upper left first molar region. There is marked rarefaction.

with the exception of this one case, any one of these cases in which curettage was the only operation performed in the mouth. In that instance, the removal of the third molar, the patient's health was appreciably better after the operation, and it was the only thing done near that time. As to the time to operate after the removal of the teeth, I mentioned the fact that these operations had been performed one year after the extractions. This was the minimum time. In most of these cases, the teeth had been extracted so long before that we were unable to get an exact time statement from the patient. I do not believe that I could give you the figures on any of them except the first one I showed, which was approximately a year. Possibly one or two others were at about a year's time, but most of those that I have shown were cases in which the tooth had been extracted from three to ten or twelve years previously. There is no question in my mind that these inflammatory changes and reactions go on for an indefinite period until there is a surgical interference. On the other hand, I must admit also that undoubtedly many extractions are performed in which infection remains in the tissue and in which the inflammatory change following extraction provokes a sufficiently severe regenerative impulse in the tissue that finally all of the inflammation and infection is carried off and new, healthy bone is laid down. Otherwise, we should seldom see a healthy jaw from which any infected teeth had been removed, because it is not only not customary to do much curetting in those cases, but also, in many instances, the tooth is removed and that is the end of it; it does not even have postoperative treatment. There is something about the resistance of certain patients that makes it impossible, apparently, for Nature to rid the jaws of this infection, and it persists for many years. The matter of bone regeneration in periapical areas of the teeth which have undergone root treatment is very important, and I mention the subject of bone regeneration in these residual areas very definitely with that thought in mind that we should have to examine these periapical areas carefully from now on to find out whether they are as healthy as the roentgen rays would seem to indicate. I have no evidence on which to make that point, but I am glad that it was raised because it should receive just as careful attention as the matter that I am speaking of, and we must leave it open for future investigation. We have tried to get specimens from such cases at the college. We have a number of patients who have shown this filling in of bone in teeth that have had root-canal treatment there, and we have tried to get them to let us perform a periapical operation for the removal of this tissue, often making the plea that they needed an apicoectomy. So far, we have not succeeded in inducing any patient to submit to it. Possibly, the material can best be obtained from cases in which, for some other reason, extraction of a tooth previously root-treated is required. No effort was made along bacteriologic lines on these cases except the first ones, which were cared for in private practice. The others were cared for at the college, and I felt that we were not

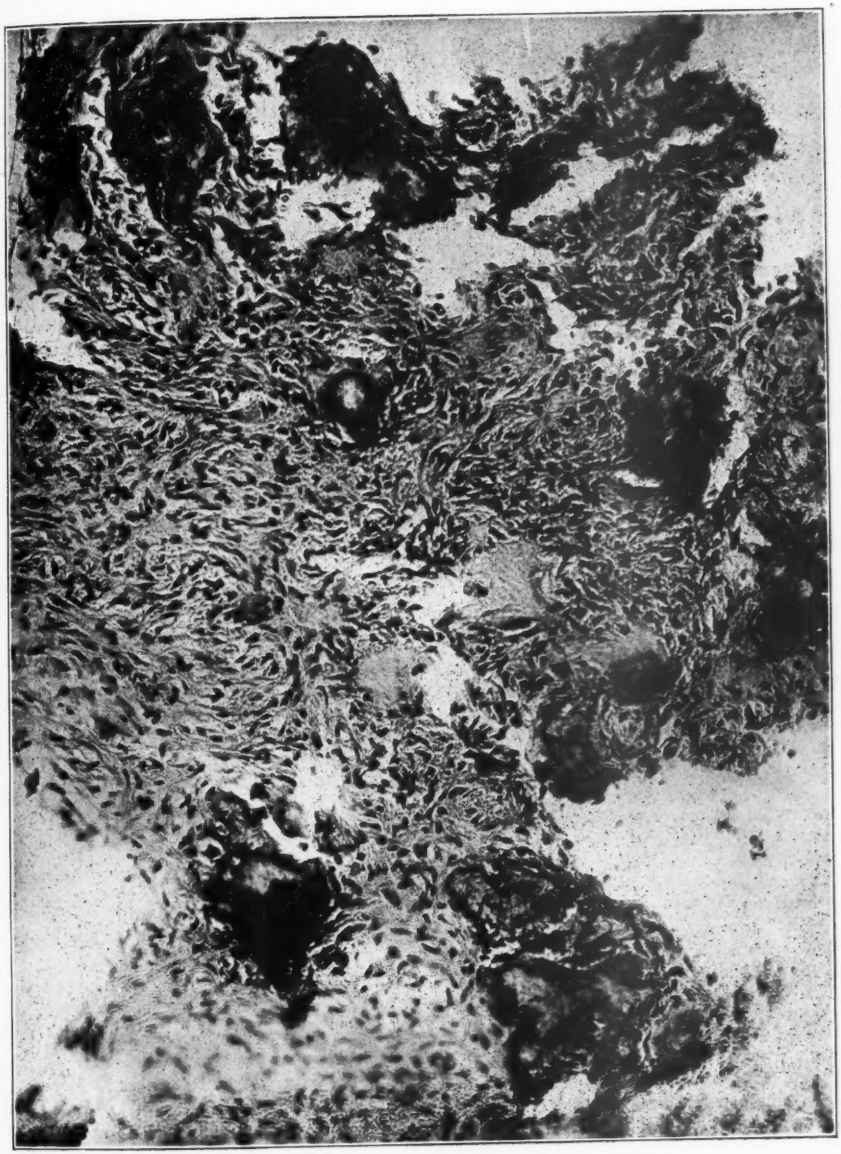

Fig. 28.—Tissue removed from the area indicated in Figure 27. Fibrotic tissue and fibroblasts may be noted.

ready to make bacteriologic examinations. I found that our bacteriologic department was not using what I refer to usually as the Rosenau medium for these examinations, and I felt that other mediums were likely to be unsatisfactory or at least I was uncertain as to what they would show. I wished to be sure that the technic was such that it would be absolutely reliable; but that is our next step unquestionably. These cases do not show external symptoms. The reaction in the tissue seems to be so mild in most of them that we do not see signs of redness, swelling or tenderness, and the explanation of that, I think, must rest entirely on the fact that these organisms produce so little reaction in the way of inflammation. The inflammation present is of a very low grade, such as is seen at the apex of an infected pulpless tooth. A large number show no external symptoms of inflammation at all, and yet the inflammation may be more severe than in some of the cases here shown. As to differential diagnosis, that is an extremely difficult question. The best that we can hope for at the present time is for each one of us to study his roentgenograms; that is, to study particularly the edentulous areas, and make a mental comparison or a comparison with other cases which you know are healthy and see whether the tissue will pass muster. Everyone will make a mistake now and then, but the percentage of error will be slight. In most of the cases in which we say, "This looks like an infected area to me," our diagnosis will turn out to be correct in at least 75 per cent of cases. We may say that we would not like to operate in one of these areas unless we had evidence that there is really trouble there; but the operation is a fairly simple one. It seldom requires the loss of a tooth, and consequently it does not prejudice the future welfare of the mouth. It is a matter of transitory discomfort and something positive has been eliminated. Many men in the field of general surgery recommend operations which are distinctly exploratory when they are unable to make a positive diagnosis except by actually operating, and we are justified in doing the same thing for the patients who are suffering from metastatic disease and in whom other possible foci have been eliminated. These are uncertain cases in many of which a little careful inspection will reveal the abnormality of the tissues so positively that we will have no hesitation in recommending an operation. The type of cells mentioned by Dr. Kronfeld has been a troublesome subject, and perhaps it is just as well to bring it out in the open. I recognize the difficulty that he mentions as to just exactly what cells we are dealing with here. It is a subject which I have gone over pretty carefully with Dr. Darlington and Dr. Neustadt, and they have been unable in many instances to say just exactly what cells these were that we were dealing with, but we have been pretty careful and, in the cases that I have shown here, we have tried to exclude the cellular groups or masses which might be considered normal. Many times, we have seen tissues in which there was apparently a hyperplasia of cellular elements, with no blood cells present, simply a greater proliferation of the tissue cells of the part than we would think was normal, but we have tried to exclude those unless, in another part of the specimen nearby, there was distinct evidence of inflammation. What the appearance is after operation I cannot say because practically all of these patients have been operated on within the past year, and if after removing a tooth we allow a year to elapse before we make a diagnosis of residual infection, we must, of course, give at least an equal amount of time for the regeneration of that tissue after the operation. So that is another matter on which I shall have to report at some later date. Of course, we shall follow these up by the roentgen rays, and I hope to be able to report at another meeting on this same series of cases or at least a number of them that we can get back for examination. Dr. Adams asked me if a root tip which was left in the bone after extraction might later assume the same density as the surrounding bone. That is not likely. We have one specimen which Dr. Neustadt prepared from a mandible which was in condition to afford a good specimen, and which we found, on roentgen-ray examination, had a dense mass in the tissue that apparently was a condensing osteitis. On examination, it was found that it was obviously a root tip, but, in the course of the inflammation following that, it had been absorbed and bone was laid down in its place, bone of abnormal density, so that, in the roentgenogram we really could not say whether it was a root tip or simply overdense bone, but the evidence of inflammation

was there, nevertheless, and in seeing these cases in a roentgenogram, I should not hesitate to recommend operation or the removal of such a mass of material, whether it proved afterwards to be bone or root tip. That would be an academic question rather than a practical one from the standpoint of the patient's health.

MAXILLARY SINUS DISTURBANCES AND METHODS OF TREATMENT*

By R. BOYD BOGLE, M.D., D.D.S., Nashville, Tenn.

DISTURBANCES of the maxillary sinus have attracted the attention of the dentist and rhinologist and have led to an eager attempt to solve the cause and determine the treatment, with the hope of control and relief.

There has been and will continue to be a difference of opinion between the dental surgeon and the rhinologist as to the causative factors until a common ground of better understanding has been reached. One criticism made of the dental profession has been that they do not view the causative factors of the diseased maxillary sinus as broadly as they should and that they are too prone to place stress on infections of dental origin. The criticism has been made of the rhinologists that they consider the causative factors only from their point of view. In seeking for truth, it should always be the objective to determine from every possible approach the origin of infection, unnecessary surgical procedure being eliminated to every possible degree in order that the best interest of the patient may be considered. It should be the earnest endeavor of every one to determine as nearly as possible all the influences which may be playing a part in any given case of maxillary sinus disturbance.

The examination of the patient from the dental point of view is of as much importance as from the rhinologic. Many, no doubt, recall that, in the influenza epidemic during the World War, many cases were observed which doubtless had their origin in infection through the nares. It is true that the lowered resistance of the lining of the sinus, whether or not due to lowered body vitality and which is probably increased by the presence of dental infection, aggravated the onset of the attack. It is also true that the pathologic conditions in the nasal passage may have been responsible, to a degree at least, for the gravity of the conditions observed. In some cases, neither a dental nor a nasal complication could be determined, and the diagnosis was that a purely influenzal infection was responsible. In a number of cases of acute sinusitis, relief has been effected by the use of local heat in the form of the infrared ray or hot moist packs used sufficiently long to produce relaxation of the membranes of the nose and to thin, so to speak, the contents of an engorged sinus that drainage might be established. This condition, of course, would be one of engorgement and not a definitely diseased condition. An acute engorgement, if not relieved, frequently leads to a

*Read before the Section on Oral Surgery and Radiography at the Midwinter Clinic of the Chicago Dental Society, Jan. 14, 1930.

condition of mucopurulent engorgement with its attending complications. No matter what the cause of the onset, it should be seen to early in management of the case that the patient has the care of a competent internist that proper elimination, rest in bed and supportive treatment may be assured. This is conducive to systemic resistance to infective processes.

Examination should be made of all suspicious teeth. A roentgenographic examination is always advisable even in the face of negative vitality tests. Not infrequently a deep pyorrhea pocket has been found in close proximity to the antral floor, where the presence of diseased disintegrated tissue of markedly lowered resistance, with a virulent infective process present, has, by infiltration, caused a lowered resistance or even infection of the lining of the sinus.

In how many cases of subapical infection, even though the sinus lining has not been disturbed or even perforated at the site of infection, are patients suffering from absorption of the toxins of this infection! Many cases have been observed in which the osseous structures have been destroyed and the infection lies between the antral lining and the adjacent bone structure. Later, the lining may become involved to the extent that it cannot further withstand the progress of the infection, which gains entrance into the sinus. Many cases of dental origin, when observed early, can be relieved by the removal of the foci without contamination of the sinus; that is to say, if the floor of the sinus is involved, it does not follow that the sinus should have a radical opening through the alveolar process, but by careful removal of the infection without forcing it into the sinus or producing undue injury, the symptoms frequently subside. Some cases no doubt have been aggravated, or even established, by improper curettement of the floor of the sinus, which primarily were not involved to any great degree. Nature is one of the best fighters of disease if she is aided and not abused. I do not mean to convey the idea that the presence of marked necrosis should not have proper attention, but I do say that wise surgical judgment and care should always be a consideration of first importance. Teeth not in close proximity to the maxillary sinus may be responsible for maxillary sinus disease. Subapical infections of cuspids not infrequently have progressed into the sinus. In one case that I recall, the lateral incisor was found to be the offending tooth. While these cases may be extremely rare, their occasional occurrence should cause the dental surgeon to be alert in his examination to determine if possible the presence of any dental foci of infection. When in consultation with the rhinologist, the dental surgeon should be able to give a complete report as to the condition of the teeth, the alveolar process and the soft tissues of the case under consideration. Conditions in the nasal passage likewise should be reported on by the rhinologist, the probable source of infection through the nose or the accessory sinuses being noted.

The lack of normal drainage from the maxillary sinus is conducive to disease. The cause of lack of drainage, whatever it may be, should be corrected if the health of the sinus is to be conserved. Improper ventilation and drainage is always a bad omen, and when we add to this any condition which retards Nature's activities, we have present a condition which sooner or later contributes materially to the lack of health. In the examination of the maxillary sinus, a great deal of stress is placed on transillumination. This is not positive in all

cases and is often misleading. Likewise, the presence or absence of pus in the nares is not a positive factor in diagnosis. There have been cases in which sinus involvement was present and no pus was present in the nose; transillumination and roentgenographic examination were negative, and yet there was a definite involvement of the sinus. The presence of polypoid degeneration in some cases may not be determined by any of the foregoing tests unless an adjunct to roentgenographic technic is used.

Roentgenograms of the sinus, posterior-anterior as well as lateral, should be made, and again, in many cases, this does not reveal the true condition. It is granted that, in many cases, the roentgenographic results will be satisfactory; while, in others, the defects will not be found unless additional aid is given to the roentgenographic technic. As stated before, irrigation of the sinus does not always give positive findings. It destroys the cilia so necessary to the health and well being of the lining and should be used only when indicated. Opaque solutions can be used to a great advantage in the diagnosis of certain paranasal sinus conditions. The injection of lipiodol has been found to be the least painful and, all things considered, the most satisfactory solution. Lipiodol is a preparation of oil of poppy containing 40 per cent, by weight, of iodin. The iodin content makes the preparation opaque to the roentgen-ray and it is also antiseptic. Lipiodol has a very pleasant effect when injected into a chronically inflamed sinus. Injected once or twice a week, it has proved to be of value. It remains in the sinus for four to six days, and is not harmful if swallowed. The maxillary sinus holds from 6 to 12 c.c. The method of injection is by syringe with the nose packed with moist cotton to prevent escape of the solution while roentgenograms are being made. Roentgenograms and transillumination will not always give the desired information as to the condition and content of the maxillary sinus. Posterior-anterior and lateral views should be made before, as well as after, the injection of lipiodol for comparison. They suggest the value of having a general physical examination, including blood examination.

Drainage and ventilation is best accomplished through the naso-antral wall. Cysts and polyps are best inspected and removed through the cuspid fossa. Gauze saturated with sterile petrolatum is used for packs following operation. Medicinal treatment should be used that in the judgment of the operator seems indicated to meet the needs of the individual case. Overmedication and treatment are to be guarded against, as Nature will often do her work of repair well if assistance is rendered her.

DISCUSSION

B. F. Andrews, Chicago, Ill.: The maxillary sinus has been the battlefield of contention between rhinologist and oral surgeon ever since these two branches of surgery have become specialized—a sort of "no man's land" between the two camps. It is not my purpose in the discussion of this paper to criticize the one or to uphold the other, but rather to seek to point the way to a common ground of understanding, and hence, to greater efficiency in the treatment of these unfortunate patients. A brief reference to the anatomy of the maxillary sinus may help in the solution of our common problems. The sinus is situated laterally to the nasal chamber, and separated from it by the naso-antral wall, which is composed of thin bones and a membranous portion. The floor is the alveolar process of the maxilla, while its roof is the floor of the orbit. It is lined with mucous membrane of the ciliated type, similar to that lining the nasal chambers, but with this difference: It has fewer blood vessels and fewer mucous glands, and is not supplied with erectile tissues as is the nasal

mucosa, especially those parts which cover the middle and lower turbinate bodies. The normal opening, or ostium maxillare, as viewed from the sinus side of the naso-antral partition, is usually very high, and occupies a position just underneath the roof. As seen from the nasal side, it emerges from the lateral nasal wall into the middle meatus, laterally from the middle turbinate, just below the opening from the frontal sinus and near the openings from the middle and anterior groups of ethmoid cells. The function of this ostium maxillare is to provide free ventilation of the sinus, and also a means of exit for any liquid discharges that, for any reason, may accumulate within it. The function of the ciliae is, by their wavelike movement, to assist in ventilation, and also, by the same movement, to carry to, and to expel through, the ostium maxillare any fluid contained in the sinus. The sinus in its normal state is devoid of fluid, and the mucous lining is only moist enough to maintain free movement of the ciliae. The arrangement of the middle turbinate in the nasal chamber is such as to provide a thin, rapidly moving current of air past the ostium-maxillare with each breath, and thus, through alternate suction and compression of the air within the sinus, secure its necessary ventilation and drainage. The pathologic condition of the sinus, common to oral surgeon and rhinologist, is infection with pyogenic micro-organisms. These organisms reach the sinus either through the mouth, or through the nose, and in some cases possibly by both. Lowered resistance or vitality undoubtedly plays a large part in any given case of antrum infection, whether of oral or of nasal origin. When of dental origin, the infection usually finds entrance through the alveolar process from some area connected with diseased teeth, gums or bone, a diseased condition which may be the cause of the lowered resistance, as Dr. Bogle has stated. The mouth teems at all times with micro-organisms of the saprophytic, or filth, type, as does the nose with all sorts of air-borne and pus-producing germs. Primary infection of the antrum of nasal origin finds its way through the ostium maxillare, and sets up an acute suppurative process, such as we find in acute colds, influenza and other contagious diseases. Secondary infection has its origin in some diseased area in the nose, or in some other accessory sinus as, for example, the frontal or the anterior or middle groups of ethmoid cells. In other words, the maxillary sinus may become, and often is, the cesspool for suppurative discharges from other sinuses, which pour through the ostium maxillare into it. The diagnosis of suppurative antrum disease of dental origin rests upon inspection of the teeth, vitality tests, transillumination of apices and the antrum itself, and roentgenography, which Dr. Bogle has so beautifully demonstrated by the use of lipiodol solution. His method shows other conditions present in the sinus, as polypi, tumors and cysts. The diagnosis, from the rhinologist's point of view, includes transillumination and roentgenography, and also a careful examination of the nasal cavity for abnormalities of the septum and turbinate bodies which might obstruct free nasal breathing, free ventilation and drainage. It also determines the presence or absence of suppuration in other of the accessory sinuses. The point at issue between oral surgeon and rhinologist is as to the primary focus of infection; and the determination of this focus of infection will often suggest the means and methods to be employed in alleviating the condition. It stands to reason, therefore, that if the infection is found to be of dental origin, the treatment of the case should be begun and carried on by the oral surgeon. If, after the employment of all the means used in locating carious roots, pus-pockets, necrotic bony areas and suppurating gums, the results are negative, it would seem that the cause must lie within the realm of the rhinologist, and the treatment of the case would rest with him. And if there should be any question in the mind of the oral surgeon as to whether the sinus may not be playing the part of a cesspool for the other sinuses, even in the presence of the pathologic conditions in the mouth just mentioned, he ought to feel justified in calling the rhinologist to his aid. Likewise, the rhinologist who is suspicious of pathologic processes of the mouth in any given case of antrum disease should, in fulfilling his duty to his patient, feel bound to seek and to use the knowledge and skill of the oral surgeon. It is only when the two branches of surgery which you and I represent, whose common arena of activity is the maxillary sinus and whose desires for the patient's best interest are paramount, can and will work in cooperative harmony that our patients' best interests be served. In the treatment of these cases, whether undertaken by oral surgeon or

rhinologist, it should be remembered that the micro-organisms inhabiting the mouth are rather violently pathogenic when transferred to the sinus and nasal mucosa; and also that bacteria indigenous in the nose are not, as a rule, pathogenic in the mouth. It would seem reasonable, therefore, that when it becomes necessary to open the maxillary sinus either through the alveolar process or by way of the canine fossa, an opening of sufficient size should also be made through the naso-antral wall into the nasal chamber for purposes of treatment and drainage, and that the mouth wound should be allowed to close and heal as rapidly as possible, and thus reinfection of the sinus be prevented. Again, as moisture is a requisite for the development of micro-organisms in any locality, the use of lavage in these cases would seem to aggravate rather than to alleviate, and currents of warm dry air injected at suitable intervals would prove more effective.

Frederick F. Molt, Chicago, Ill.: It is probable that the majority of rhinologists who feel keenly that their duty to their patients requires curing and not temporizing with maxillary sinusitis are alive to the possibilities of dental infection in this connection. The point on which there is not so much unanimity of opinion is as to what constitutes dental infection. There are, of course, the gross and readily apparent periapical masses and pyorrhea pockets approaching or intruding into the antrum floor—conditions, indeed, that cause us to wonder that there has not been an acute and serious involvement—but the roentgenographically negative pulpless tooth must be considered in many cases of chronic sinusitis. The term "roentgenographically negative" is used in reference to the dental roentgenogram and in a large proportion of these cases, if carefully examined by amplifying the dental roentgenogram with antero-posterior and lateral head plates, using lipiodol, as Dr. Bogle has suggested, it will frequently be shown that these teeth are not so negative. I cannot but feel that there was more real meat in Novitsky's suggestion, fifteen years back, regarding what he called "antrum drain," than he was or is credited with. In so many of the cases in which we have occasion to operate and in which we find polypoid formation immediately above these presumably harmless teeth, we find verification for this theory. On this basis, treatment or operative interference while these potential disturbing factors are permitted to remain is bound to present a dearth of results. When sinus disturbances occur, therefore, the rhinologist should not overlook such a causative or contributory source of infection. Whether he believes a large or a small percentage of actual sinusitis cases originate from a dental focus, pulpless teeth should in such cases be retained on parole and under observation entirely. My own experience in regard to transillumination, the presence or absence of pus in the nose, antrum puncture and roentgenography without lipiodol is that no one of these diagnostic efforts is by itself entirely dependable and frequently all together leave some element of doubt. The use of lipiodol in roentgenography seems to be more positive. In any case in which a dental factor is to be eliminated under any circumstances, and in which there is still some doubt, the area from which the tooth is extracted may readily be utilized in making an exploratory puncture into the antrum floor. A moment's delicate and aseptic examination of the anesthetized sinus area will suffice to determine whether or not a chronic polypoid hypertrophy, an accumulation of caseated pus or gelatinous encrustations or a cyst exists. If such conditions are found, the exploratory incision may be enlarged to permit a completed operation, however extensive. In this connection, I wish to differ from Dr. Bogle in regard to the advantage of the canine fossa operation. If an area is available for approach in the molar or bicuspid region, it presents distinct advantages on four points, over the canine fossa *per se* or when included in the Caldwell-Luc operation: 1. It is the pendent portion of the sinus. 2. Drainage, if necessary, and irrigation, if indicated, may be accomplished more readily from this point. 3. Closure of the flap may be achieved with less immediate or protracted postoperative discomfort and with more positive results. 4. The occasional sensory disturbance to the mucosa on the labial portion of the ridge and even to the lip is avoided in its entirety. With these facts in its favor, it is not surprising that many rhinologists are making those cases in which teeth must be extracted and periapical areas curetted cases for collaboration, the oral surgeon carrying out the sinus curettage and the rhinologist assuming the necessary postoperative treatment. The patient is the gainer by this liberal attitude. By this meth-

od, the mucoperiosteal flap is raised on the buccal aspect of the ridge and the process removed over the buccal roots of the tooth or teeth, these being extracted, and the chiselling judiciously carried upward on the buccal aspect to present a sufficiently large opening for complete approach to all parts of the sinus. The crest of the ridge is not disturbed, and when, after curettage, the flap is restored, the condition remains most favorable for restoration. If there is no dental condition requiring elimination, the case is purely a rhinologic one and its treatment should usually not be attempted by the dentist. As Dr. Bogle has pointed out, satisfactory ventilation is essential. To enter such an antrum from below, leaving the ostium occluded by hypertrophied turbinates, a deflected septum or nasal polypi, is absurd and useless, as the septic condition will inevitably recur. To revert to older methods of procedure, retaining an opening into the mouth by the use of a guttapercha plug or of continuous redressing is not logical. As quickly as is possible, the normal condition should be brought about, and no normal antrum opens into the mouth. I think Dr. Bogle might profitably have emphasized that an accidental invasion during extraction, unless tooth roots or infectious débris is carried into the sinus, does not call for irrigation, packing or treatment, and that a gratuitous entrance into the antrum is never to be condoned.

A PLEA FOR FAIR PLAY

By F. S. MEYER, D.D.S., Minneapolis, Minn.

IN the May, 1930, issue of THE JOURNAL appears an article by C. S. Van Horn, discussed by Wilmer Souder of the Bureau of Standards. I wish to call attention to certain statements made by Dr. Souder in the course of his discussion which I feel are out of place.

On page 772, second column, line nine, he says, "That technic is being revived, apparently, by those who have not yet discovered this article, which is eighteen or twenty years old. It does us no harm to give credit where credit belongs." It is very apparent at whom this statement is aimed. But Dr. Souder evidently has not discovered that other men besides Dr. Van Horn worked on the expansion technic and wrote on the subject eighteen to twenty years ago. He fails to see that that technic is not being revived but is being discarded by those who are making any progress in the work. If he wishes to give credit where credit belongs, as he says he does, why does he not state who was the first to attempt to measure the shrinkage of gold from the molten to the solid state or to measure the expansion or contraction of wax per unit of heat?

On page 771, in the fifth line of his discussion, he says, "Now we add to that a special method of getting the wax out of the mold. If you do that, I think you will be up to date on the many certain ways to produce perfect inlays."

Since 1909, I have used the expansion technic in my office. In 1912, an article written by me appeared in the July issue of the *Dental Cosmos*. However, we were all far from our goal, because our investments were not suited for the expansion technic. It was not until we discarded that technic and coated our wax patterns with a cold heavy inner and a warm outer investment that we

really accomplished anything worth while. And that was started in my office, as far as I know. I am making this statement to refute the inference that our technic is an old one revived.

As to the steam elimination, I shall let time and the profession be the judge of that. With it, we have succeeded in casting inlays, crowns and bridges that could be easily seated on porcelain and amalgam models. We have cast full mouth bridges that could be seated on as high as seven abutments without retouching. Has the man who sets out to reflect on us accomplished as much?

On page 773, first column, line fifteen, Dr. Souder says, "The parasite manufacturer who has no research laboratory and no responsibility can think of just as descriptive and just as powerful adjectives as the legitimate manufacturer. He can send just as attractive men and just as smooth talkers as the conscientious manufacturer, but he cannot send you accurate, verified data on dimensions." Accurate, verified data on dimensions mean very little when not obtained under the same conditions under which our work is carried on in practice. To be of the greatest value, they must be obtained from investment confined within a ring with the wax and moisture eliminated the same way as in practice. Even the rate of elimination may alter the data. Is Dr. Souder so interested in certain so-called legitimate manufacturers that he can call those who infringe on their business parasites? He speaks of those using descriptive and powerful adjectives. Is there one sentence in his whole discussion which we can take home with us and make use of in our practice? If there is, I fail to find it.

What I should like to know is what right Dr. Souder has to discriminate between one manufacturer whom he calls legitimate and another whom he calls a parasite. What right has he to slur members of the profession who are honestly striving to improve dentistry?

On page 781, column one, line seventeen, under "proposed tentative specification for dental casting investment," he says, "Only one type of material is required." By what right can he discriminate against those technics requiring two types of materials? Has he reached a stage so high in the practice of dentistry that we must all look up to him for guidance as to what manufacturer to buy from or what technic to follow?

Again, on page 781, line ten, column two, he says, "Hand mixes will be spatulated thirty seconds, mechanical mixes fifteen seconds." He says nothing about the number of revolutions per second of the mechanical mixer. Does he not know that some investments when mixed with a mechanical mixer run at high speed may set very much faster than if the mixer were run at a low speed? Does he not know that the method of pouring the water onto the investment powder or the investment powder into the water may very materially alter the quality of the mix and the time of setting? Or is he of the opinion that we should use a standardized mixer and a standardized motor set for a certain speed? On page 780, column two, line one, he says, "The tests, necessary to insure compliance with the specification, are not difficult to perform." How is anyone going to perform these tests when he is not given full instructions for mixing the investment? Does he not know that more water must be used to obtain the desired "slump" if the mixer is run at a high rate of speed than would be needed if the motor were run at a lower speed? That would materially alter the final result.

PULP PATHOLOGY FROM THE STANDPOINT OF THE CLINICIAN*

By EDWARD H. HATTON, B.L., M.D., Chicago, Ill.

THE tooth pulp is enclosed within a rigid wall and can be approached only through the root canal or by penetration through this wall. In this respect, it is somewhat like the brain and the bone marrow.

The pulp serves at least three purposes. In the first place, it produces part of the tooth, the dentin; in the second place, it carries on whatever metabolic process takes place within the tooth substance; and, in the third place, it is part of the nervous system. In all of these phases of its activity, it is like any other similar organ of the body, so that within the limitations of its structure, it reacts as do other tissues of the body to stimuli, irritation and injury.

No matter what one may believe about the vitality and metabolism of enamel, we know that it is with difficulty, if at all, that injurious agents penetrate intact enamel layers, and it is only when the enamel covering of the dentin is broken that the pulp begins to react to them. On the other hand, it must be admitted and granted that as soon as the enamel layer becomes defective, the pulp is no longer protected from the destructive effects of injury. The same may be said of changes in the arrangement of the tissues at the neck of the tooth, at least to the degree that the cementum becomes denuded. The cementum acts to a less degree like the enamel, but is thinner and more permeable, and, therefore, less efficient as a protective layer over the relatively porous dentin.

The susceptibility of the dentin arises from its relatively porous character, penetrated as it is with minute tubules, and from the structural character of the contents of these tubules. The structure and the function of the soft tissue extensions of the odontoblasts, Tome's fibers, contained within these tubules, are not only susceptible to the effect of injury, but these structures also serve equally well to transmit injuries to the pulp. It may be a matter of discussion as to just how these tissues function and just what the structure essentially is, but I think it is agreed that they do serve to transmit impulses to afferent nerves, that they are the site of metabolic activity and that they are readily permeable to substances in solution or in a state of fine division.

Therefore, as soon as the dentin is exposed in any fashion whatever, degenerative and retrograde changes are set up in these tubular contents, that is, Tome's fibers. This is not only what should be expected but is also capable of ready demonstration by histologic and experimental methods. Even diffusible chemicals, if deposited on denuded dentin, are

*Read before the Section on Oral Pathology at the Midwinter Clinic of the Chicago Dental Society, Jan. 14, 1930.

carried not only to the pulp, but even to remote parts of the body as long as the tubules contain soft tissues or retain their porous character. That the consequences of this situation are not more serious is due solely to the final character of these degenerative changes and not to any benign provision of the body. The reactions are not different in any essential respect from the reaction to the same type of injuries elsewhere in the body, though, in most of such cases, the reaction is distinctly harmful and not protective, as, for example, when they occur in artery walls.

These changes occur in the tooth as a result of caries, abrasion and erosion. As soon as the dentin is exposed in any of these conditions, the change is identical, whether produced by mechanical injury, the toxins of bacterial origin or those injuries of chemical or thermal origin. Metabolic activities in the tubules are interfered with and, as one result of this low-grade metabolism, free fat can be demonstrated in these tubules and supposedly within Tome's processes. Free fat is never found by staining or chemical methods in these tubules as long as they are not damaged, and its presence is the first striking evidence that degeneration has begun. At a little later stage in the degenerative process, again presumably because of the change in the metabolism and probably because of the accumulation of a matrix of nonvital organic matter in the tubule, lime salts are no longer kept in solution and are deposited or precipitated in this dead organic matrix filling the tubule, and the tubular contents become calcified. Both of these changes are in a way, and most fortunately so, protective. The transmission of the injurious factors through the fat is measurably less than through the intact Tome's fiber, and the calcified layer, if reasonably complete, is almost totally impervious to these forms of injury. In abrasion, there is no further change in this calcified core filling the tubules, except as the result of further abrasion. How different it is when the same changes take place in an artery wall!

In caries, the process is different, as the acid formed by the bacteria dissolves out this calcified core, the bacteria proliferate through the degenerated tubular contents before they become calcified or the diffused acid prevents the precipitation of lime salts. This is the best explanation for what happens in arrested caries and for the appearance of dentin adjacent to the caries-involved hard tissue, provided the process is reasonably slow. In the so-called translucent or transparent dentin, the tubule contents are calcified, the darker borders on either side only partly so, as the lime salts are on one side being precipitated and on the opposite side being dissolved.

The changes that occur in the pulp depend only on the nature and extent of the damage done to the pulp tissues. These are of a fourfold character, and in two respects exactly like those in the dentin tubules, that is, fatty changes and calcification. Involution is a third; that is, the more robust tissues persist or even increase in amount and the more specialized cells atrophy and disappear. This begins with the odontoblasts and the other cells that form dentin, and the ability to produce secondary dentin is limited at first and finally lost. Not only do the fibrous tissues persist the longest, but their property of producing intercellular substances is increased to such a degree that this intercellular substance is far removed from its parent cells, metabolism being thus lowered and calcification en-

couraged. Of course, circulation is interfered with, congestion occurs and vascular changes are initiated which end in total obstruction of vessels with further interference with nutrition of the essential pulp cells.

A fourth change has to do with the penetration of bacteria into this region. These, as a rule, come through the cavities made by dental caries, but they may be carried into the pulp by the blood stream. In either case, pulp abscesses are initiated. These abscesses, for a time, remain rather sharply localized, the length of time depending only on the character of the invading germs. As a rule, the spread of the abscesses is not a continuous process of extension, but they advance by a series of jumps like the spread of a fire by burning brands carried in a high wind. Eventually, these abscesses are carried to the apex, and the apical infection is initiated. At the apex, the involvement, except in acute cases, is not often associated with the formation of pus. It extends toward the bone and outward along the pericemental membrane, ending with the formation of a typical granuloma, sparing for a time the cementum and the cementum-forming tissues at the apex.

Clinically, the dentist rarely uses the term "pulp abscess" for these conditions, but speaks either of a gangrenous or a putrescent pulp. The terms are virtually synonymous, although putrescence is always associated with a foul odor, due probably to the character of the bacteria found in the process, and gangrene is merely the death of a whole organ, due to failure of nutrition, that is, to the complete failure of the blood supply or drainage of the part.

Damage to the pulp results from entrance of the injurious material through the apical opening, interference with the circulation at this critical point or ingress of the agent through the hard tissues of the root; that is, the causal conditions are systemic in origin, the agents being in the form of bacteria, their toxins or other substances dissolved in the blood. Damage may result from injury or mechanical changes at the apex, such as the formation of pulp nodules at or near the apex; or the toxins may diffuse into this region from the pericemental membrane, either through the apical opening or through the root of the tooth.

The first and second methods of injury are so apparent that they need no further explanation; but since pulp changes are so common in teeth in association with pyorrhea, perhaps some explanation should be offered as to just how pulps are damaged and retrograde processes set up that end in various types of pulp atrophy, including the fibrous form with hyaline changes, fatty changes involving the nerves and the regions about the odontoblasts and eventually calcification. Neither explanation is wholly satisfactory, and perhaps it may be that both conditions play a part. Some of the changes indicate that the process is quite local and bears a definite relationship to the process on the outside of the tooth. In other instances, it is quite general, which suggests that entrance of the toxic material was not through the tooth substance but by way of the apex.

The application of such facts as these to the practice of dentistry must be obvious. As soon as the dentin is exposed, the pulp is exposed, perhaps not technically, but theoretically so. Unless this exposure is compensated for by the degenerative changes that take place in the tubular contents, or by the type of artificial restoration supplied by the dentist, the

exposure is no longer theoretical but actual. If this is true in the small cavities of caries, in the comparatively small areas exposed by abrasion and erosion, what of extensive caries and the larger area of exposure in the preparation of cavities? What does it teach about the character of the materials placed next to the dentin in the restoration of lost tooth substance? What about the restoration of the loss of extensive amounts of tooth substance by large amalgam and inlay restorations? What are the hazards of such large restorations? Are they comparable to the hazards of making teeth pulpless in such situations? Is it better to take the chance of occurrence of a pulp abscess under a large inlay or amalgam restoration and the apical involvement that will surely follow such an operation if the pulp is not fully protected in one way or another? Or is it better to treat and fill such a pulp canal before the apex becomes involved?

It is not my purpose or function to answer such questions definitely, but merely to point out conditions that exist and to suggest this point of view to the practicing dentist. Each case is a problem in itself and must be settled on its merits. I have seen teeth abraded to the gum margins and the condition entirely compensated by the formation of secondary dentin and the retrograde changes that have taken place in that dentin, without involving the apex and without any hazard to the health or well-being. On the other hand, a comparatively moderate abrasion may extend into a pulp horn and set up the whole train of changes that end only in the involvement of remote parts of the body.

Efforts may be made to save teeth involved by pyorrhea in which the pulps have undergone such extensive degeneration that they are not worth saving. On the other hand, teeth equally seriously involved may have only slight changes in the pulps and respond well to therapeutic measures of the same character.

Finally, one should remember that not only are pulpless teeth a possible source of systemic involvement, the source of tenderness, pain and neuralgia in the head region, but also there is a group of teeth that must have the same careful consideration: teeth carrying large restorations, teeth whose pulps are the site of pulp calcifications and teeth with slight superficial caries but in which the carious process has already involved the pulp in extensive degeneration even to the formation of abscesses.

DENTAL INLAY CASTING INVESTMENTS: PHYSICAL PROPERTIES AND A SPECIFICATION*

By N. O. TAYLOR,† Ph.D., GEORGE C. PAFFENBARGER,† D.D.S., and W. T. SWEENEY,‡ A.B., Washington, D. C.

THE common types of dental inlay casting investments have been developed by the admixture of various materials with plaster of Paris. Very few data on the composition and properties of investments were available until the publication of the results of Coleman's[1] study of the accessory materials used in the casting process. This paper gave data on the physical properties of a considerable number of dental investments.

In 1929, Souder and Sweeney[2] made a survey of the properties of investment compounds and drafted tentative requirements for casting investments. A survey of inlay casting technics was undertaken in 1929 as a part of the cooperative research work on dental materials at the National Bureau of Standards. In connection with this survey, studies were made of the properties of the various types of materials used in the casting process.

Particular attention was given to the properties of casting investments with the objects of determining: 1. The physical properties of the current casting investments. 2. The requirements of a satisfactory inlay casting investment for general use. 3. A specification for inlay casting investments for the American Dental Association.

PROPERTIES OF CASTING INVESTMENT

Samples of thirty-eight casting investments of all types were secured in the open market. The physical properties of these materials and of one investment developed in the Bureau laboratories were determined in accordance with the test methods outlined by Souder and Sweeney. Slight modifications were made in the method of determining crushing strength. Additional data were secured on several properties not listed in the requirements. The chemical composition of the materials (determined by W. W. Walton, J. G. Wangler and E. E. Maczkowske of the Chemistry Division of the Bureau

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*Cooperative research by the National Bureau of Standards and the American Dental Association.

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*This paper is one of three presented as a symposium. The two other papers will appear in January, with the discussion of the three papers.

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1. Coleman, R. L.: Bureau of Standards Research Paper No. 32, Bur. Standards J. Res., December, 1928.

2. Souder, Wilmer, and Sweeney, W. T.: Tentative Specifications for Dental Casting Investment, J. A. D. A., 17:780 (May) 1930.

TABLE 1.—PROPERTIES OF CASTING INVESTMENTS

Sample	Chemical Composition*				Fineness					Permeability K X 100
	Plaster of Paris Per Cent	Insoluble Matter† Per Cent	Boric Acid Per Cent	Graphite Per Cent	On Sieve No. 100 Per Cent	On Sieve No. 140 Per Cent	On Sieve No. 170 Per Cent	On Sieve No. 200 Per Cent	Through Sieve No. 200 Per Cent	
1	54.5	42.0	0.2	.....	1.5	3.0	3.5	6.0	85.5	1.0
2	54.0	35.0	0.3	.....	0.0	1.0	0.5	1.5	97.5	1.5
3	49.5	50.0	.....	.....	0.5	0.5	1.0	1.0	96.5	1.5
4	46.0	50.0	.....	.....	52.0	4.5	3.0	4.0	36.5	0.5
5	45.5	54.0	.....	.....	1.0	2.0	3.0	5.0	89.0	1.0
6	41.5	52.0	.....	.....	0.5	0.5	0.5	1.0	97.5	1.5
7	40.0	50.0	.....	.....	3.5	6.0	5.0	5.5	80.5	0.5
8	37.5	59.0	1.8	.....	1.5	4.0	3.0	5.0	86.5	1.0
9	37.5	60.0	.....	.....	3.0	2.0	2.0	1.5	92.0	1.0
10	37.5	57.0	.....	5.0	6.5	2.0	1.5	2.0	88.0	0.5
11	36.5	54.0	.....	.....	36.0	1.5	1.5	2.5	59.0	1.0
12	35.5	60.0	.....	.....	4.0	5.5	3.5	5.0	82.0	2.0
13	35.0	58.5	0.3	.....	1.0	2.0	4.0	4.5	89.0	3.0
14	34.5	58.5‡	.....	.....	7.0	41.5	13.5	3.5	35.0	2.0
15	34.0	62.5	.....	1.8	4.5	2.0	3.5	4.5	85.5	1.0
16	33.5	61.5	.....	2.1	2.5	1.0	1.5	2.5	92.5	1.0
17	32.5	45.5	.....	.....	7.0	4.0	5.0	5.5	79.0	1.0
18	32.0	35.0**	.....	.....	6.5	3.5	4.0	6.0	79.5	1.0
19	32.0	66.0	1.5	.....	1.0	2.0	2.5	6.0	88.5	2.5
20	31.0	64.0	1.0	.....	1.0	0.5	1.5	3.0	93.5	5.5
21	30.5	65.5	.....	.....	2.0	1.5	2.0	1.5	93.0	1.0
22	30.5	69.0	.....	.....	1.0	2.0	2.0	3.5	91.0	1.0
23	29.0	71.0	.....	.....	0.5	1.0	1.5	2.5	95.0	0.5
24	29.0	57.0	.....	3.0	3.0	1.5	1.5	1.5	92.5	0.5
25	28.0	69.0	.....	0.6	1.0	1.0	2.0	2.5	93.5	1.0
26	27.5	69.5	.....	.....	7.0	7.0	3.0	3.5	89.5	1.0
27	26.5	72.0	0.5	.....	0.5	1.5	3.0	5.5	90.0	2.0
28	26.5	70.0	.....	.....	16.0	7.0	4.5	4.0	68.5	0.5
29	26.0	73.0	.....	.....	24.0	31.5	14.5	6.5	24.0	2.5
30	26.0	71.5	.....	.....	16.5	20.5	10.0	5.5	48.0	2.0
31	26.0	70.0	.....	.....	1.0	1.0	1.0	2.5	94.0	2.5
32	25.5	73.0	0.8	.....	1.5	2.5	2.0	4.0	90.5	1.0
33	25.0	74.0	.....	.....	24.0	5.5	0.5	2.0	68.0	1.0
34	24.5	75.0	.....	.....	0.5	1.5	3.5	3.5	90.5	0.5
35	24.5	68.5	1.1	.....	2.5	1.5	2.0	1.0	93.0	1.5
36	24.5	74.5	.....	.....	3.5	2.5	2.5	1.5	90.0	0.5
37	22.5	75.5	.....	.....	0.5	1.0	1.0	1.5	95.5	0.5
38	20.0	79.5	.....	.....	1.0	0.5	0.5	1.0	97.0	0.5
39	19.5	78.5	1.8	.....	1.0	1.0	1.5	3.0	93.5	1.0

*No attempt was made to determine coloring matter or small amounts of impurities.
†Mainly silicious.
‡Contains asbestos fiber.
**29.5 per cent magnesium oxid.

of Standards), determinations of particle size and a figure on relative permeability are given in Table 1.

The proportions of plaster of Paris, boric acid and graphite were determined, as well as a general group classed as insoluble materials, which included silica and other silicious materials. No attempt was made to determine the amount of coloring matter and small amounts of impurities. Magnesium oxid was determined in one sample (No. 18) in which it was evident that it existed in large proportions. The fineness of the materials was obtained by screening the dry powder through standard sieves, according to the procedure in U. S. Govt. Master Specification No. 248, volume 3, page 3, 1925.

The relative permeability to air was determined on a series of test pieces prepared from mixes of investment and water in the proportions used as the standard testing consistency and discussed later in connection with the other properties of the materials tested. Specimens were dried at 300 C. (572 F.) for one hour prior to testing. The specimens were in the form of tapered cylinders, the two

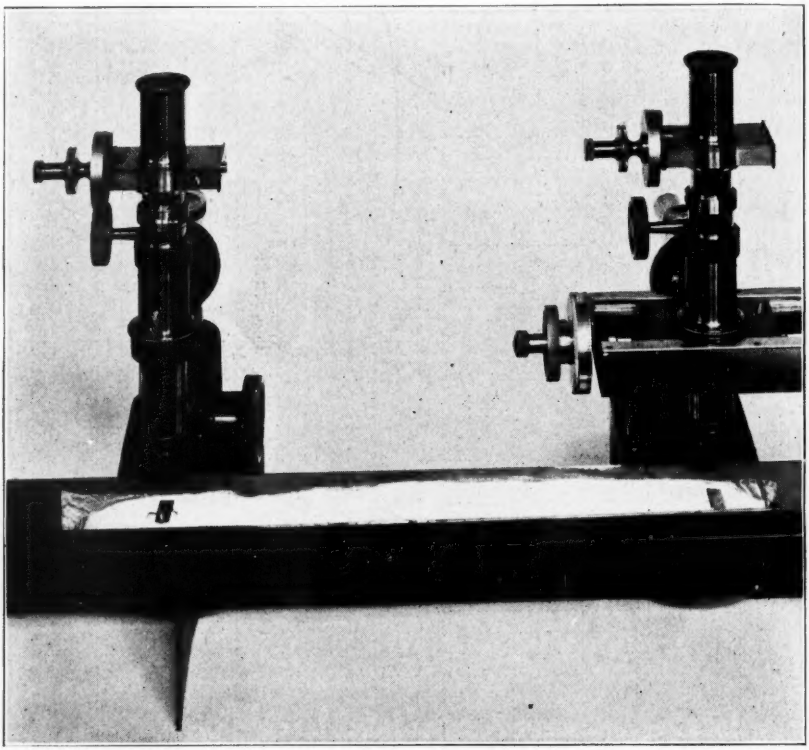


Fig. 1.—Comparator used in determining the setting characteristics of casting investments.

TABLE 2.—PHYSICAL PROPERTIES OF DENTAL CASTING INVESTMENTS

Sample*	Testing Consistency W/P Ratio	Setting Time Minutes			Setting Expansion Per Cent	Thermal Expansion (Per Cent) of Original Length from Room Temperature to								Crushing Strength Pounds per Square Inch
		Vicat	Gilmore Initial	Gilmore Final		100 C.	200 C.	300 C.	400 C.	500 C.	600 C.	700 C.	Cooled to Room Temperature	
1(M)	.50	15	17	27	.28	.15	.15	.15	−.15	−.20	.00	+.08	−1.11	1,880
2(I)	.65	8	8	16	.25	.10	.08	.04	−.10	−.81	−.67	−.64	−2.30	1,560
3(M)	.70	9	11	25	.16	.16	.20	.13	−.16	−.20	−.05	−.01	−1.60	1,280
4(S)	.42	9	9	18	.24	.10	.09	.09	−.10	−.44	−.22	−.20	−2.20	760
5	.45	9	9	19	.26	.13	.14	.09	−.13	−.19	−.05	.03	−1.28	1,810
6(I)	.60	10	12	21	.18	.11	.13	.11	−.12	−.15	.06	.17	−1.20	500
7	.40	10	9	32	.25	.06	.07	.20	.22	.28	.45	.58	− .48	730
8†	.40	23	24	32	.33	.15	.18	.23	.31	.34	.55	.66	− .84	640
9	.40	16	16	24	.38	.14	.22	.28	.18	.21	.47	.61	− .60	1,700
10	.41	8	8	18	.45	.14	.17	.16	.03	.03	.28	.32	− .74	590
11(S)	.30	15	14	19	.27	.13	.15	.19	.17	.22	.54	.68	− .61	1,160
12(M)	.42	41	39	55	.01	.10	.12	.19	.29	.26	.38	.60	− .71	780
13(O)	.60	5	6	52	.25	.08	.06	.07	.07	−.22	−.17	−.15	−1.70	210
14(S)	.65	22	22	.....	.21	.15	.16	.17	−.04	−.15	−.15	−.21	−1.21	340
15	.42	23	23	36	.23	.13	.16	.19	.06	.11	.44	.53	− .90	1,090
16	.40	19	19	32	.16	.11	.15	.21	.12	.18	.50	.59	− .86	1,160
17(O)	.45	14	15	27	.18	.16	.20	.24	.12	.15	.37	.47	− .90	870
18	.45	24	25	34	.08	.29	.34	.40	.43	.33	.41	.48	− .88	2,140
19	.38	42	42	51	.32	.13	.13	.18	.26	.34	.60	.78	− .63	360
20(I)	.55	75	85	180	.02	.14	.17	.24	.25	.30	.57	.68	− .75	440
21	.40	36	36	51	.34	.14	.18	.24	.21	.31	.63	.78	−1.10	470
22	.42	11	12	20	.25	.14	.17	.22	.08	.15	.45	.59	− .80	1,070
23†	.40	16	17	32	.24	.09	.13	.19	.28	.33	.66	.82	− .63	720
24	.40	8	7	15	.27	.12	.15	.20	.17	.16	.44	.57	− .59	1,350
25†	.42	13	13	24	.33	.14	.17	.21	.20	.29	.65	.76	− .65	980
26	.35	13	13	23	.25	.10	.14	.15	.23	.21	.44	.62	− .80	1,230
27	.40	21	21	32	.30	.12	.13	.17	.16	.30	.60	.75	− .48	300
28(S)	.32	21	19	40	.31	.14	.18	.23	.23	.36	.32	.81	− .38	570
29(O)	.31	12	12	25	.26	.16	.19	.22	.18	.29	.59	.64	− .90	770
30(S)	.38	9	9	21	.30	.15	.17	.21	.10	.18	.50	.63	− .82	900
31(O)†	.40	9	9	20	.30	.15	.19	.23	.26	.33	.65	.82	− .29	820
32†	.36	21	21	32	.37	.15	.17	.23	.26	.32	.65	.80	− .46	440
33(O)	.35	13	12	21	.32	.15	.20	.26	.26	.40	.74	.89	− .13	260
34†	.42	5	5	17	.34	.18	.41	.83	1.18	1.23	1.26	1.27	− .20	990
35	.50	7	7	10	.12	.09	.10	.15	.26	.33	.64	.73	− .92	340
36†	.35	7	8	12	.49	.16	.22	.27	.25	.37	.64	.85	− .60	560
37(I)	.40	15	14	26	.18	.17	.21	.27	.21	.28	.59	.76	− .37	260
38†	.40	10	13	28	.31	− .04	.04	.10	.12	.20	.56	.70	− .77	540
39	.35	13	12	27	.29	− .16	− .15	− .10	.10	.29	.64	.82	−1.20	250

*In this column, (I) indicates that manufacturer classifies this material as an inner investment; (O), as an outer investment; (M), as a model investment; (S), as a soldering investment.

†Meets the specification as outlined in this paper.

ends being parallel and the length approximately 1 inch. The smaller end was 1 inch in diameter: the taper, one fourth inch per inch on the diameter. Air under a pressure of 10 pounds per square inch was forced through the samples and the amount of air passing through the sample in ten minutes was recorded. A value for the permeability of the materials, K (number of cubic centimeters of air which would pass through a cubic centimeter of material in one minute if the pressure difference causing the flow is one gram per square centimeter), was calculated as recommended by T. C. Adams[3]: $K = \frac{LV}{AHT}$ where L = length of sample (cm.); V = volume of air passed through the sample (c.c.); A = area of sample (sq. cm.); H = pressure (grams per square centimeter), and T = time minutes), all units being in the metric system. The tabulated data give values 100 times K as determined by this formula.

Table 2 contains the majority of the data on the physical properties of the casting investments studied.

The first test made on each investment was the determination of the standard testing consistency. Water and powder were proportioned so that the resulting mix, when spatulated in a small mechanical spatulator by 100 turns of the stiff blade in approximately fifteen seconds and poured in a cylindrical mold 2 inches long and $1\frac{3}{8}$ inches in diameter, would slump when the cylinder was lifted, until the average external diameter of the pat was between $2\frac{1}{4}$ and 3 inches. The cylinder was raised two minutes after the mix was started and the reading taken one minute after the cylinder was lifted.

The testing consistency having been determined, all other samples were prepared using the water-powder (W/P) ratio found to be the correct one.

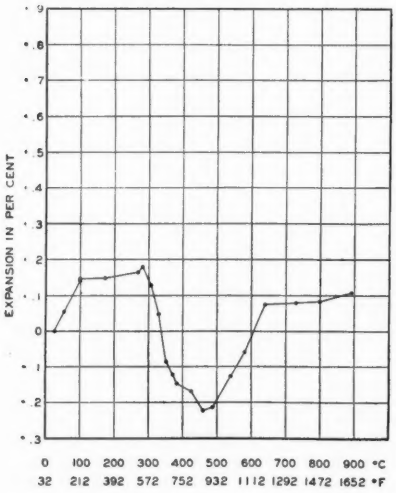


Fig. 2.—Thermal expansion curve of investment No. 1.

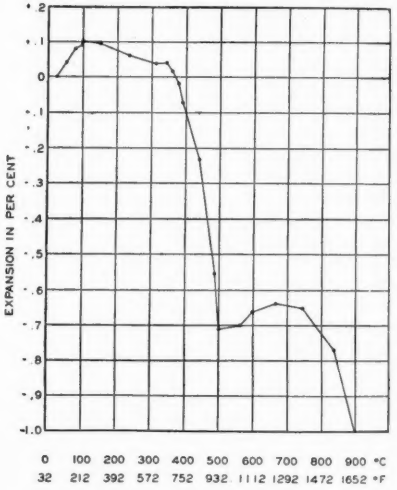


Fig. 3.—Thermal expansion curve of investment No. 2.

3. Adams, T. C.: Tr. Am. Foundryman's Ass'n 31:114, Part 2, 1924.

Setting time was determined by the use of standard Gilmore and Vicat needles as outlined in the A.S.T.M. 1927 standards. The Gilmore needles were useful in determining the interval between the initial and the final set.

Setting expansions were determined by the use of comparator microscopes. Figure 1 shows the equipment used for this purpose.

The thermal expansion data on the materials studied (Figs. 2-40) were determined with the fused quartz expansion apparatus as described by Hidnert and Sweeney.[4]

The crushing strength values were determined by preparing five cylindrical samples 1.3 inches in diameter and 2 inches long. These samples are considerably smaller than the 2 by 4 inch samples used in testing plasters. This size of sample was adopted in preference to the larger one because of the fact that they represent the largest quantity of material which can conveniently be mixed in the common types of dental mechanical spatulators. The item of cost of material is of some consequence when working with some of the "special" investments which sell for approximately a dollar per pound.

The thermal expansion curves of all of the investments studied are given in Figures 2 to 40 inclusive.

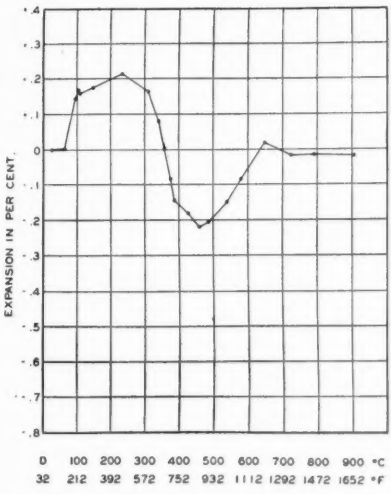


Fig. 4.—Thermal expansion curve of investment No. 3.

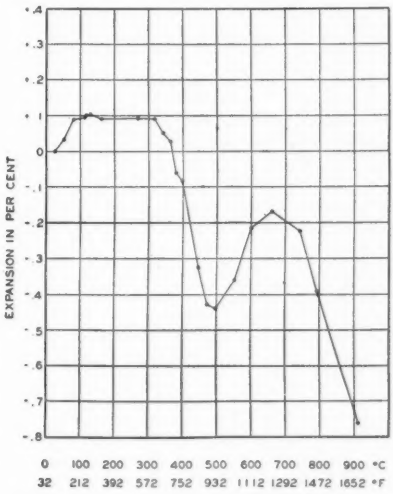


Fig. 5.—Thermal expansion curve of investment No. 4.

COMMENT ON DATA

The data given in the preceding section were obtained from a study of the current investment compounds. Studies of the various factors entering into the inlay casting process have given data on the desirable properties of this type of materials. A combination of the two sets of data has been used in developing a specification for inlay casting investments.

4. Hidnert and Sweeney, W. T.: Bur. Standards J. Research, November, 1928.

Many types of casting investment have been advocated for use in the many inlay technics which have been presented to the dental profession. A careful check of materials and methods revealed the fact that few of the authors of technic had given the necessary consideration to the properties of materials advocated, and that, with few exceptions, much better types of materials could have been selected to carry out the process. On the other hand few of those interested in presenting these technics have properly balanced the factors in their processes to make the best use of the materials they have suggested for use.

The production of satisfactory inlays is dependent on the production of a mold sufficiently large at the casting temperature to compensate for the casting shrinkage of the inlay gold. A complete discussion of the factors involved will be given when the work of a large cooperative committee which is studying the application of laboratory data to the development of a practical inlay technic is completed. Brief statements will be made regarding the findings of the committee and regarding laboratory experience in connection with the properties of investments at this time.

The thermal expansion of wax patterns and of investments are the two chief factors in compensating for the 1.25 per cent casting shrinkage of golds. The properties of wax patterns are such that it is far more desirable to obtain the major portion of the compensation by the expansion of the investment than to risk distortion of the thin and plastic wax patterns. The current investments do not have sufficient thermal expansion to offset completely the gold shrinkage, and so it is necessary to utilize the thermal expansion of the wax to some extent, although this should be confined to the minimum.

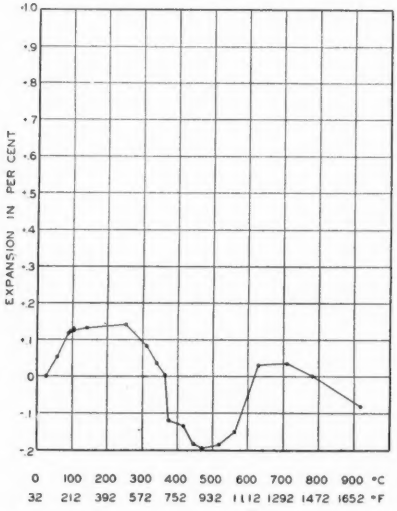


Fig. 6.—Thermal expansion curve of investment No. 5.

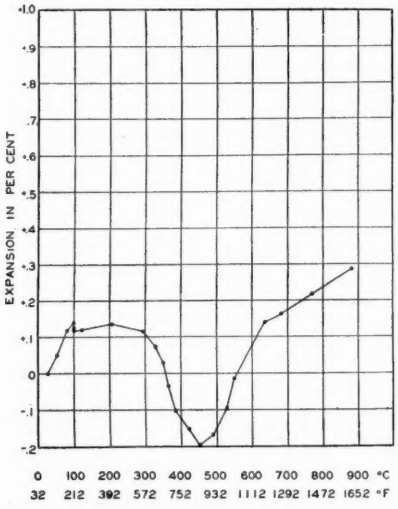


Fig. 7.—Thermal expansion curve of investment No. 6.

A consideration of the thermal expansion curves of the various investments tested shows that the materials may be divided into several general classes. These may be listed as follows:

Class I: Investments which expand slightly when heated until the water is eliminated, but which contract more or less continuously from that point. These investments contain a high proportion of plaster and are valueless for use in any technic which requires investment expansions above 0.1 or 0.15 per cent. Their very low expansion and marked tendency toward shrinkage at elevated temperatures render it very difficult to make a casting using such investments by any technic without getting an actual contraction of the mold. It would be almost as feasible to use pure plaster of Paris. This type of material is that commonly used in the "quick elimination" method of producing inlays. The common combination of no wax expansion with a shrinking investment results in castings markedly undersize. No scientific evidence has ever been submitted by their respective manufacturers which would warrant the use of this type of material.

Class II: Investments which expand slightly (from 0.1 to 0.2 per cent) when heated until the water is eliminated, then contract markedly and expand a second time; which may bring the volume slightly above the original one. These investments contain less plaster than the preceding group, but still have such large quantities of the plaster that the thermal expansion of the silica cannot compensate for the plaster shrinkage at elevated temperatures. This group of investments is recommended for certain types of technics, but their use is open to considerable criticism. Comparatively small increases of the calculated casting temperature may cause the expansion of the mold to

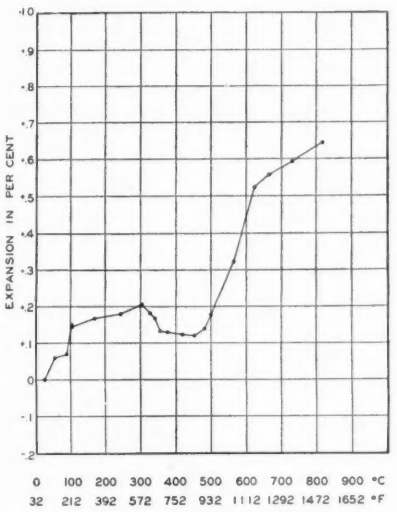


Fig. 8.—Thermal expansion curve of investment No. 7.

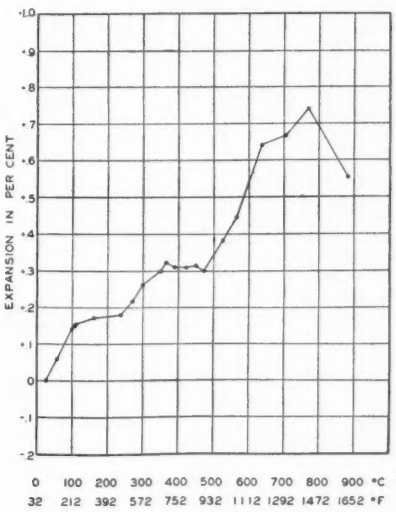


Fig. 9.—Thermal expansion curve of investment No. 8.

cease and an actual contraction ensue. The maximum expansion which can be obtained by this type of material is so small and the use of the material so critical that there seems no logical reason for its employment.

Class III: Investments which exhibit a more or less continuous expansion from room temperature to the highest temperatures at which it is practical to make dental castings. These investments are high in silica and correspondingly low in plaster content. Extremely low plaster content investments show marked expansion at higher temperature but have lower crushing strength. All investments of this type show irregularities in the expansion curve which are related to the evolution of moisture and the consequent shrinkage of the plaster. We should note particularly the flat places in the curves of this type of investment at high temperatures. These make for ease in casting since variation of the casting temperature over considerable temperature ranges has little effect on the total expansion produced. The addition of boric acid to this type of investment has a tendency to reduce these irregularities and to increase the strength at high temperature.

Class IV: An investment developed at the Bureau (No. 34, Figure 35) which has sufficient thermal expansion to compensate completely for the shrinkage of gold when properly handled. This investment which contains 75 per cent cristobalite and 25 per cent plaster of Paris, is not on the market at present, but at least one similar material is in the process of commercial development and should soon become available to the dental profession. Materials of this type will make it unnecessary to use any wax expansion and will go far toward making the inlay cast-

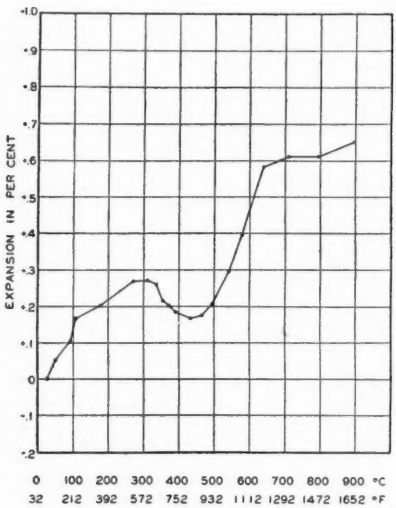


Fig. 10.—Thermal expansion curve of investment No. 9.

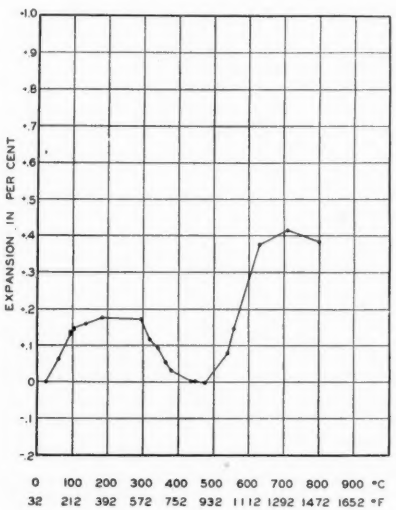


Fig. 11.—Thermal expansion curve of investment No. 10.

ing process easy to carry out satisfactorily.[5]

The investment in Class III and those investments which will in the future fall into Class IV are far superior to the other types in the production of first quality inlays. Their other physical properties may be made satisfactory if the manufacturing process is properly controlled. The addition of coloring matter and a considerable variety of extraneous materials other than boric acid seems to have little or no beneficial effect on the properties of the materials.

Graphite, which is found in a few investments, seems to be of little or no advantage owing to its low thermal expansion. Castings made with graphite-containing investments are no smoother than those made with other types of investments. It could well be replaced with silica.

The setting time of the investment is an important item to consider in outlining an inlay technic. The time of set must be long enough to allow a safe margin of time for the completion of all necessary operations before the initial set takes place. If a method is to be used that requires wax expansion after the investment is in place, the time of set must be increased to allow the expansion to take place before the setting is complete. A common fault in wax expansion methods is the use of quick-setting investments. A setting time longer than thirty minutes is neither necessary nor advantageous.

The fineness of an investment has a great deal to do with the smoothness of the surface of the castings produced through its use. The finer the investment, the smaller the number of surface irregularities which may be expected. Fineness is not the only factor governing the condition of the cast surface, and rough castings may be produced even though a finely ground investment is used if (1) too high a proportion of water is used in the mix; (2) the pattern is vibrated excessively after the investment has been poured; (3) patterns are not clean; (4) air is incorporated in the investment, or (5) the burn-out is at too rapid a rate.

The porosity of investments is commonly considered as being closely associated with their fineness. Coarse investments have commonly been considered to have high porosity owing to the large size of the particles and have been used to a great extent with this as an explanation. Actually, we find that porosity is more nearly a function of uniformity of size

5. Technic to be used in casting with christobalite investment: 1. Line casting rings with a layer of wet asbestos paper and press it firmly against the inside of the rings. Leave room for the shoulder of the sprue former at one end and trim the other end off one-quarter inch below the ring. (The thermal expansion of the investment material is considerably greater than that of the brass ring and it is necessary to use the asbestos as a cushion to allow the investment to expand properly.) 2. Mix enough investment to fill one inlay ring. Use 40 c.c. of water to 100 gm. of investment. (Laboratory mixes were made in a small stiff blade mixer, with 100 turns of the blade in approximately fifteen seconds.) Be prepared to use it immediately as the setting time is short. Have all materials at room temperature. 3. Paint a pattern with the mix. Take as large a portion of investment as possible on the brush and flow it on to the pattern. Cover the pattern rapidly, place in the ring and pour the remaining investment around the pattern. 4. Eliminate the wax and heat the mold to the casting temperature. In the absence of temperature-indicating equipment for high temperatures, heat until the ring is red hot and maintain the temperature until the mold has had time to attain approximately the same temperature as the ring. This technic, when used with the other investments that passed the specification, was found to be more accurate than many other technics which are in current use. (The water-powder ratio varies for different investments. The heaviest painting consistency is preferred.)

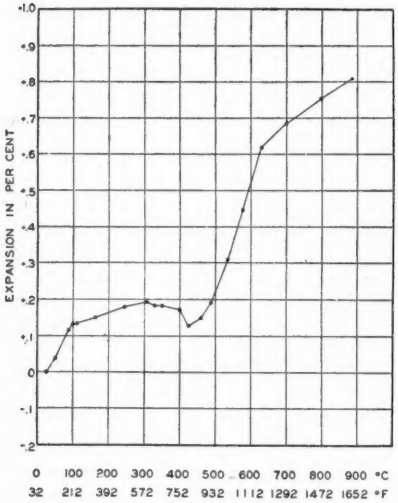


Fig. 12.—Thermal expansion curve of investment No. 11.

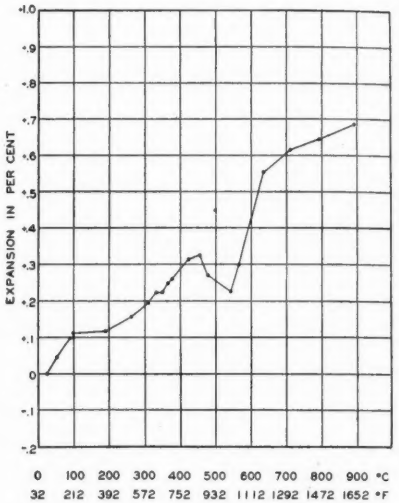


Fig. 13.—Thermal expansion curve of investment No. 12.

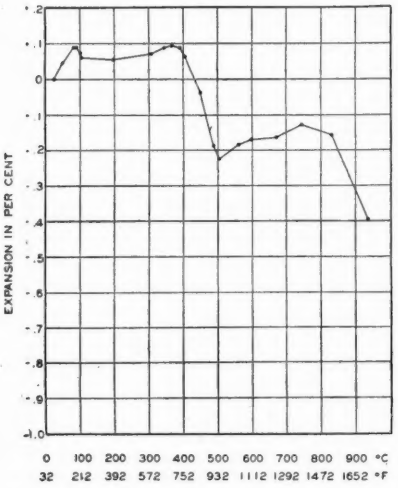


Fig. 14.—Thermal expansion curve of investment No. 13.

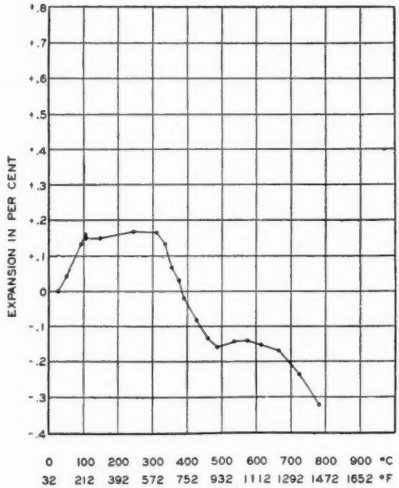


Fig. 15.—Thermal expansion curve of investment No. 14.

than of the size of the largest particles present and that many of our finely ground investments having particles of approximately uniform size have greater porosity than the coarse or soldering investments. The chief advantage of the

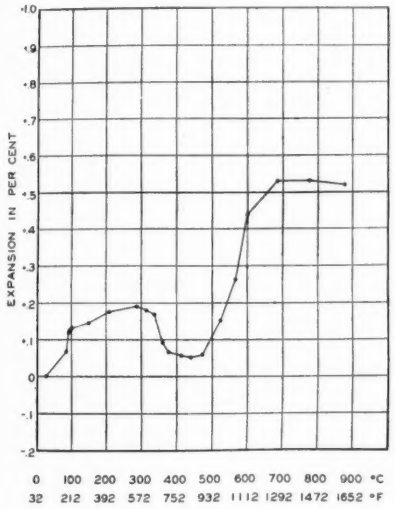


Fig. 16.—Thermal expansion curve of investment No. 15.

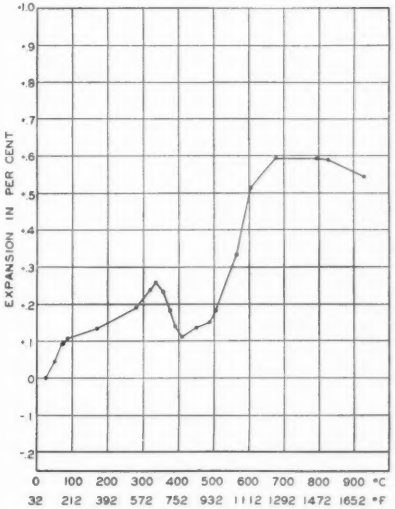


Fig. 17.—Thermal expansion curve of investment No. 16.

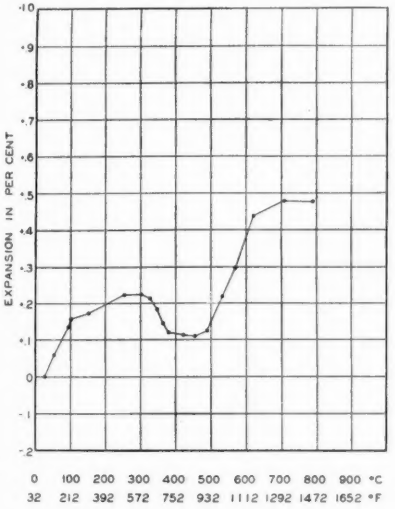


Fig. 18.—Thermal expansion curve of investment No. 17.

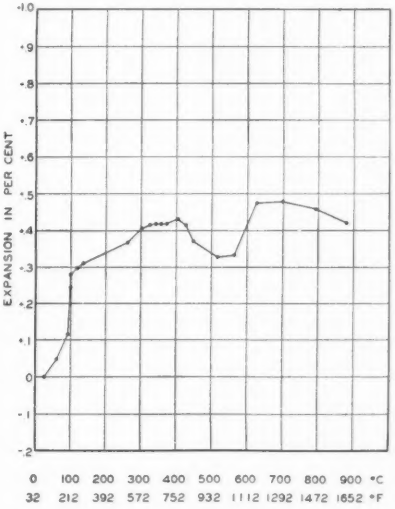


Fig. 19.—Thermal expansion curve of investment No. 18.

coarse investments is not increased porosity, but lies in the slightly lower price per pound which may be a considerable factor in making large cases.

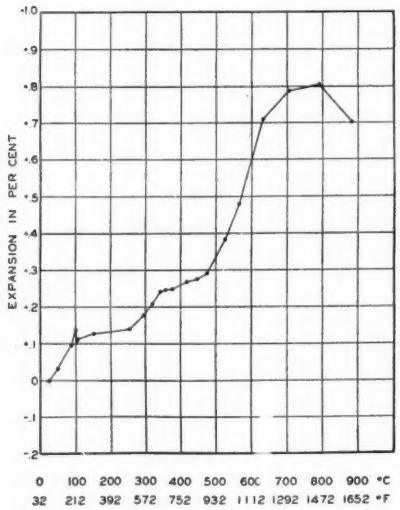


Fig. 20.—Thermal expansion curve of investment No. 19.

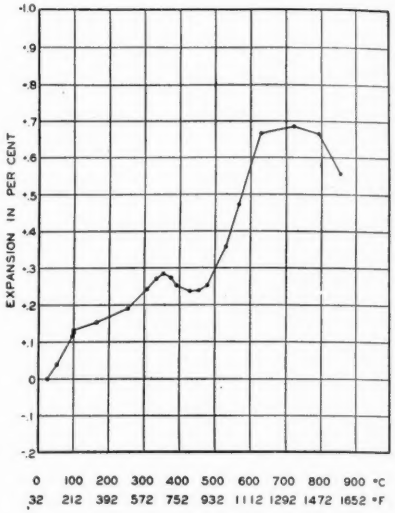


Fig. 21.—Thermal expansion curve of investment No. 20.

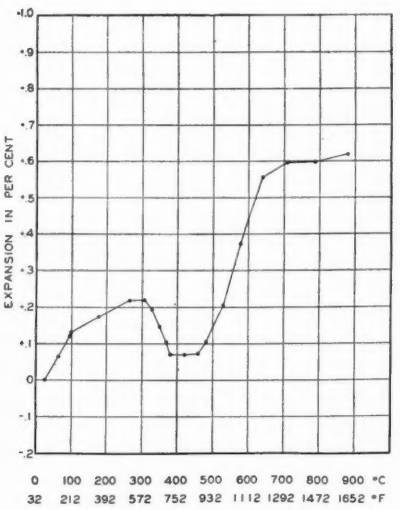


Fig. 22.—Thermal expansion curve of investment No. 21.

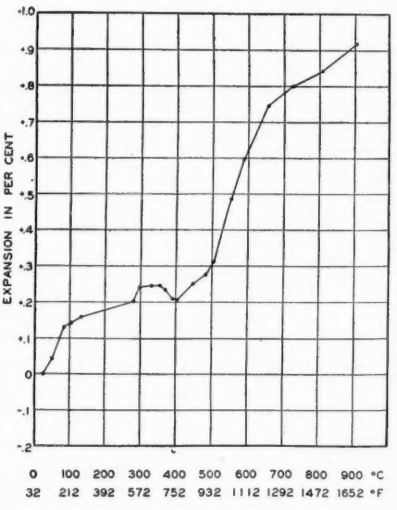


Fig. 23.—Thermal expansion curve of investment No. 22.

The crushing strength of investments varies over considerable ranges at room temperatures. Strength at room temperature is no direct indication of strength

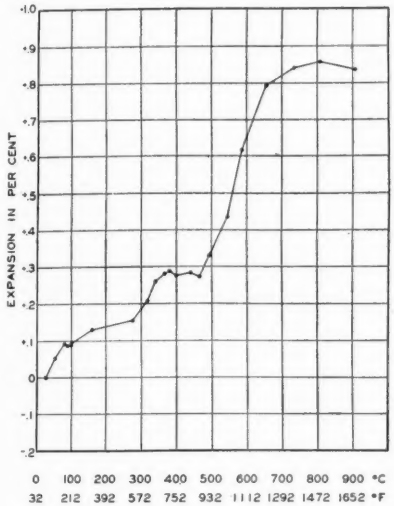


Fig. 24.—Thermal expansion curve of investment No. 23.

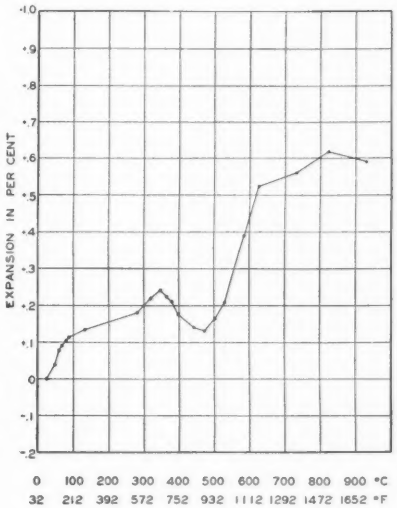


Fig. 25.—Thermal expansion curve of investment No. 24.

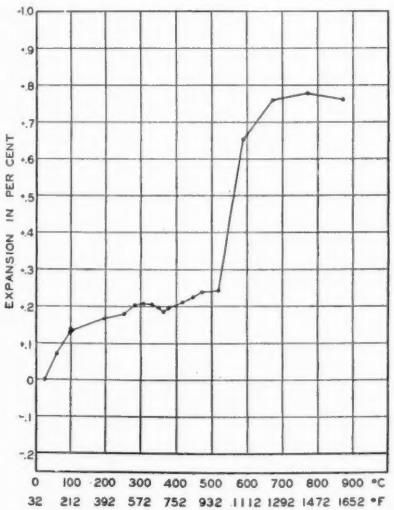


Fig. 26.—Thermal expansion curve of investment No. 25.

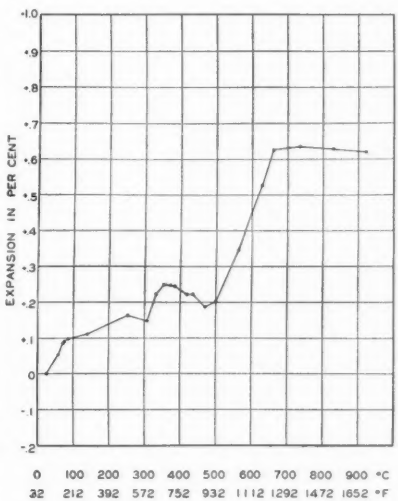


Fig. 27.—Thermal expansion curve of investment No. 26.

at high temperatures. Fortunately, most investments have sufficient strength for all practical purposes if carefully handled. Strength at room temperature is

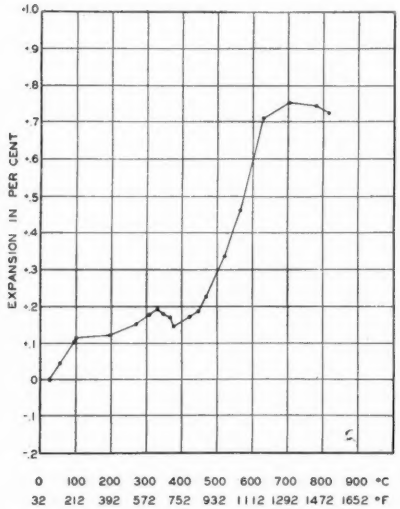


Fig. 28.—Thermal expansion curve of investment No. 27.

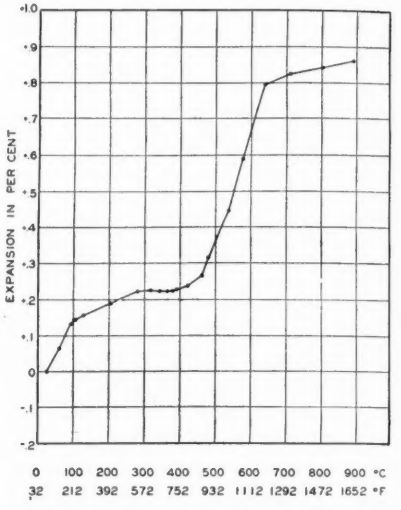


Fig. 29.—Thermal expansion curve of investment No. 28.

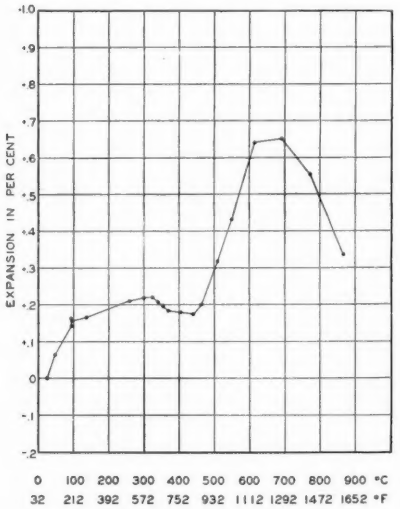


Fig. 30.—Thermal expansion curve of investment No. 29.

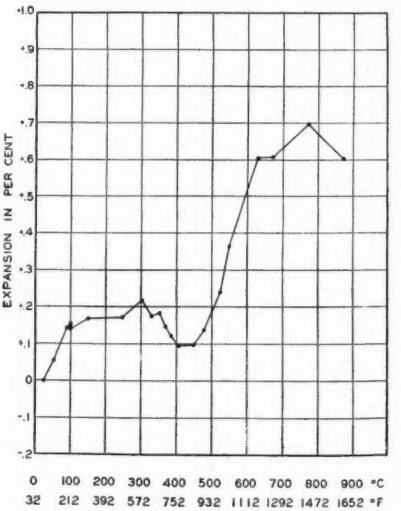


Fig. 31.—Thermal expansion curve of investment No. 30.

important in an indirect technic involving investment models.

SELECTION OF INVESTMENT FOR USE

The selection of a good investment for

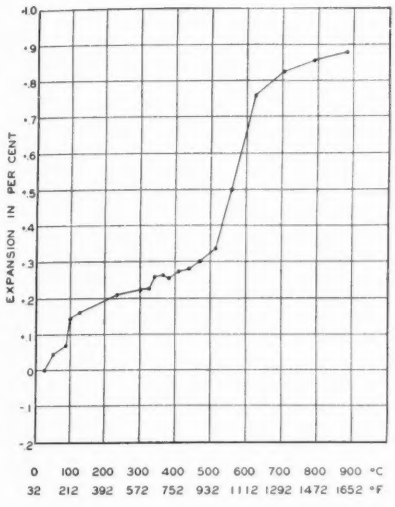


Fig. 32.—Thermal expansion curve of investment No. 31.

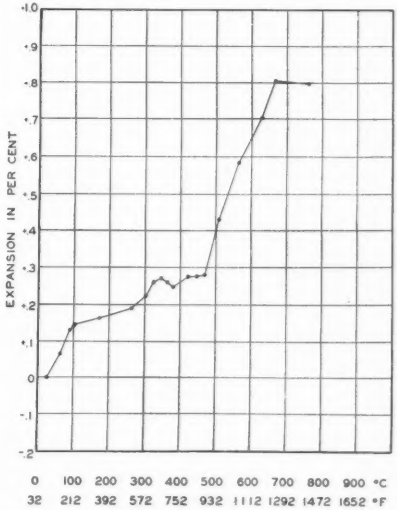


Fig. 33.—Thermal expansion curve of investment No. 32.

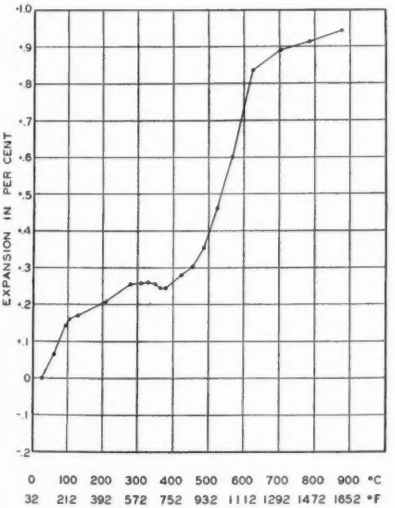


Fig. 34.—Thermal expansion curve of investment No. 33.

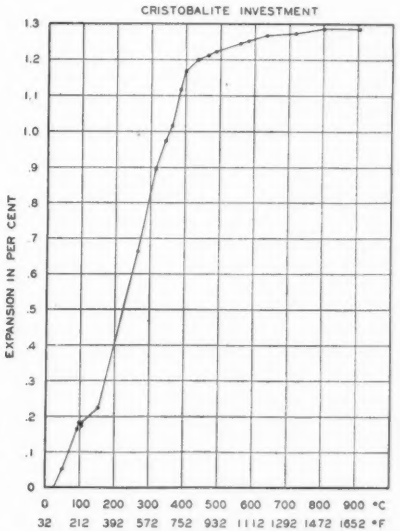


Fig. 35.—Thermal expansion curve of investment No. 34.

all-round use is a rather difficult problem at the present time. The manufacturers have not given any data and, in many cases, have no data on the behavior of

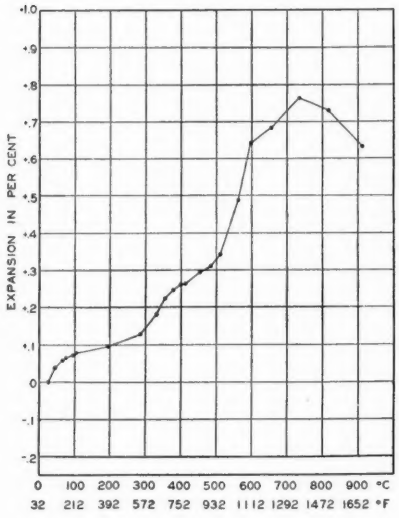


Fig. 36.—Thermal expansion curve of investment No. 35.

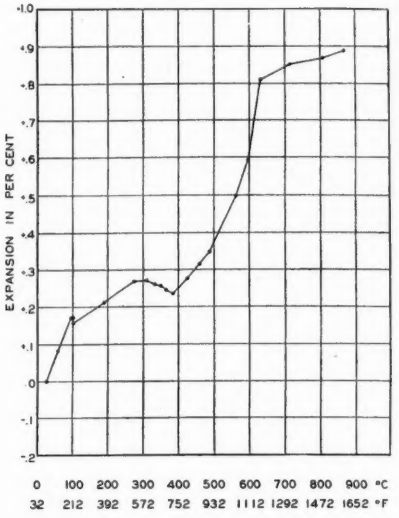


Fig. 37.—Thermal expansion curve of investment No. 36.

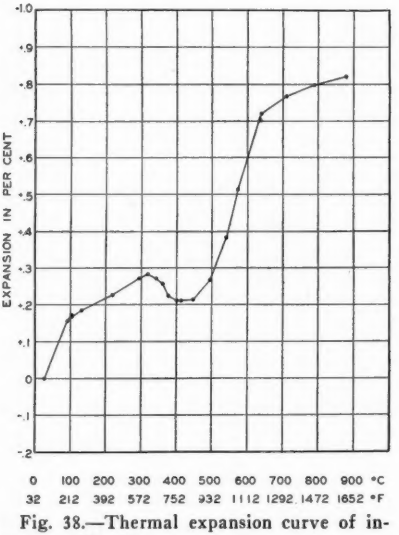


Fig. 38.—Thermal expansion curve of investment No. 37.

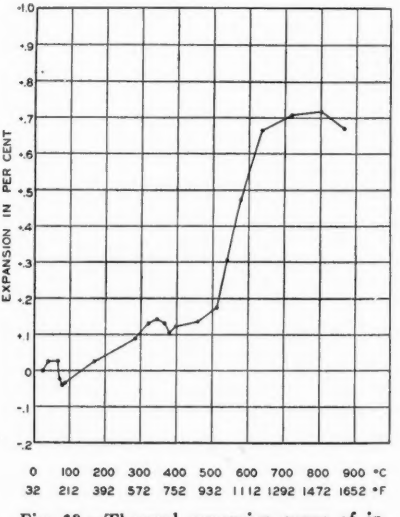


Fig. 39.—Thermal expansion curve of investment No. 38.

their products when heated. With conditions as they are, the only method of determining the quality of investments has been to try them, one after another,

until one was found that would give satisfactory results. It is hoped that the manufacturers will supply these essential data in the near future, when the selection of investments will be a much easier problem.

A few manufacturers know the characteristics of their products and are familiar with the requirements of the inlay process. Two of these firms, at least, have continued to make materials

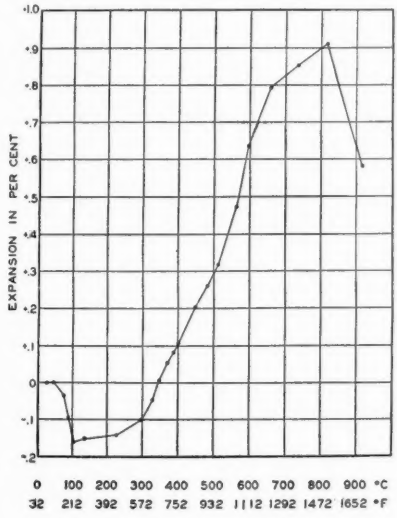


Fig. 40.—Thermal expansion curve of investment No. 39.

which they know are not the best for the purpose intended but for which they have a large and continuous sale. It is not to be expected that a manufacturer will deliberately scrap a product that is popular with the dental profession, for, in the end, the manufacturer supplies what the dentist demands. The manufacturer alone should not be criticized for delay in discarding products of doubtful value. The dental profession has been lax in its attitude on the matter of improving the quality of materials. There is no doubt that once the profession realizes the possibilities of improvement in the current materials and insists that improvement be made, the manufacturers of all types of dental materials will welcome the opportunity to make the best possible materials for all dental uses.

Mention has been made of the characteristics of general types of investments. The superior expansion properties of the Class III investments would indicate that this type is the best now available for all-round use. In this connection, there seems to be no advantage in the use of two different types of investment in pouring up a mold. It may be an advantage to use a slightly thicker mix in painting the pattern than that used for the bulk of material, but unless the item of cost would call for the use of a coarse outer investment, the same material should be used for both purposes. Class III investments have other properties which make their use desirable, but their thermal expansion properties make them almost a necessity in compensating for the casting shrinkage of gold.

There was, until very recently, no specification by which casting investments could be judged. It was felt that manufacturers of investments should have an opportunity both to assist in setting a specification and to change their products to comply with the specification so set. Accordingly, the trade names of investments were not inserted in the tabulated data in which products were rated against a tentative specification. Subsequent tests will be made of materials certified to meet the established requirements.

The specification published early this year (May, 1930) and the data secured in the recent tests of investments have been used as a basis for the specification which follows. It is felt that the ma-

terials which will meet the requirements of this specification will be satisfactory for all-round use and much superior to the average material now on the market.

A comparison of the properties of the inlay investments tested with the requirements shows that eight of the materials will meet the requirements. This group includes Nos. 8, 23, 25, 31, 32, 34, 36 and 38.

A considerable number of the materials tested were manufactured as soldering investments. Materials of this type should not be considered as casting investments nor rated against this specification.

AMERICAN DENTAL ASSOCIATION SPECIFICATION NO. 2: TENTATIVE SPECIFICATION FOR DENTAL INLAY CASTING INVESTMENT

(Approved July 24, 1930)

I. General Specification: This material shall be a powder composed essentially of plaster of Paris and silica, or material of these types which, when mixed with water in proper ratio, applied to the dental wax pattern and heated in the usual manner, will be found satisfactory for use in casting dental restorations.

II. Types: Only one type of material is required. The time of setting may be modified to suit the needs of the operator.

III. Material: The material shall be uniform and free of foreign material, partly set or caked lumps. Coloring material as such will not be regarded as foreign material.

IV. General Requirements: 1. The material shall not crack in heating. 2. The material shall not contaminate the alloy cast into it and shall not cause pitting, roughness of surfaces or voids in the alloy. 3. When heated the material shall not give off poisonous or offensive odors.

V. Detail Requirements: 1. The setting expansion shall be 0.05 per cent or over at the end of twenty-four hours. 2. The thermal expansion shall be 0.7 per cent or over when heated from room temperature to 700 C. A thermal expansion curve or sufficient data shall be supplied to enable the purchaser to make proper use of the material. 3. During the preceding test (V-2), the specimen shall not, at any temperature above 200 C., show a length shorter than the original length at room temperature, and shall not at any higher temperature show a shrinkage or decrease in length of more than 0.15 per cent of the maximum length at any lower temperature. 4. The compressive strength shall be not less than 350 pounds per square inch. 5. The time of set shall be not less than five nor more than thirty minutes and shall be indicated on the package. The time of set shall not vary over ± 20 per cent from the manufacturers' stated value. 6. Eighty-five per cent shall pass a No. 200 sieve, 95 per cent shall pass a No. 100 sieve and 100 per cent shall pass a No. 30 sieve.

VI. Methods of Inspection and Tests: 1. Sampling. Ten pounds of material taken at random shall be submitted for test. The material, if taken from original packages, shall be submitted in moisture-proof containers bearing the name of the manufacturer.

2. Testing Consistency. The investment used in making all test samples shall be mixed with sufficient water to produce a mix of "testing consistency" in accordance with the following directions to give a "slump" within the following limits: Mixes shall be spatulated mechanically by 100 turns of a stiff blade in approximately fifteen seconds. A cylindrical mold 2 inches long with an internal diameter of $1\frac{3}{8}$ inches shall be placed on a dry glass plate and filled. Two minutes from the time of starting the mix, the mold shall be lifted and the mixture allowed to slump or spread over the plate. The average of the maximum and minimum diameters of spread of the slumped mixture shall come between the limits of $2\frac{1}{4}$ and 3 inches. These measurements shall be made one minute after the cylinder is lifted.

3. Setting Expansion. The change in dimension on setting shall be determined on a 30-cm. specimen by observing the change with a micrometer microscope comparator or equipment of equal accuracy. (*Dental Cosmos*, p. 746, August, 1926; Bureau of Standards Research Paper No. 32, December, 1928, Supt. Documents, Government Printing Office, Washington, D. C., price, 35 cents.)

4. Thermal Expansion. The thermal expansion shall be measured on a specimen (1.2 cm. in diameter by 20 cm. long, approximately) by the "fused quartz expansion apparatus" method, or by the use of equipment of equal accuracy. (Bureau of Standards Research Paper No. 29, November,

1928, Supt. of Documents, U. S. Government Printing Office, price, 10 cents.)

5. Time of Setting. 200 gm. of the sample shall be mixed with enough water to make a paste of "testing consistency" (see VI-2) and tested with a Vicat needle. Setting is considered complete when the needle no longer penetrates to the bottom of the specimen. (A. S. T. M. Standards, Part II, page 32, 1927, or U. S. Government Master Specification No. 248.)

6. Fineness. Fineness shall be determined by screening 100 gm. of the dried sample through the sieves specified, and determining the amount of material remaining on each sieve. The material shall be shaken through the sieve with as little abrasion as possible.

7. Compressive Strength. The compressive strength shall be based on five specimens each prepared as follows: 100 gm. of the sample shall be mixed with enough water to make a paste of "testing consistency" and poured into a cylindrical mold, 1.3 inches in diameter by 2 inches high, the containing vessel being moved back and forth over the mold while pouring. The sample shall be worked slightly to remove air bubbles and struck off level. The cylinders shall be removed from the molds as soon as they are hard enough to handle, and stored in air at a temperature between 60 and 100 F. Tests shall be made after seven days.

In computing the average strength, any cylinder whose strength varies more than 15 per cent from the average shall be discarded. In case three or more cylinders vary more than 15 per cent from the average, the lot shall be discarded and the test repeated.

VII. Packing: 1. Material shall be packed in moisture resisting containers. 2. Accurate and adequate instructions for proportioning and manipulation shall accompany each package. 3. Each package shall be marked with a serial number or a combination of letters and numbers which shall refer to the manufacturer's records for the particular lot or batch of material. 4. The date of manufacture (year and month) shall be indicated on the package as a separate item or as a part of the serial number. 5. The minimum net weight of the contents shall be marked on each package.

VIII. Notes: 1. Manufacturers of inlay casting investments may indicate that their materials comply with this specification by (*a*) a statement on the package guaranteeing the material contained therein to meet the requirements of this specification, or (*b*) a statement as to physical properties of the material. Thermal expansion data shall be supplied in either case.

2. The American Dental Association will not assume responsibility for, or guarantee compliance of, materials so labeled by manufacturers, but will, in event of a dispute between a member of the Association and a manufacturer, act in an advisory capacity and will designate testing laboratories having equipment for testing dental inlay casting investment where necessary tests may be made.

Such packages of the following materials as were tested during the first half of the year 1930 were found to meet the requirements outlined above:

Alva Inlay Investment Compound, Hisey Dental Mfg. Co.

Cristobalite Investment.

Kerr No. 3 Investment, Detroit Dental Mfg. Co.

Dr. Meyer's Outer Investment, Barkmeyer Electrical Co.

Pyromold No. 1, Dental Products Co.

Pyromold No. 2, Dental Products Co.

R. & R. Green Investment, Ransom and Randolph.

Whip Mix Inlay Investment, Whip Mix Corporation.

This listing is alphabetical and no significance is to be attached to the order of listing.

Obviously, this list must not be regarded as proof that all packages of the various brands, sold during the first half of the year 1930, met the requirements. Nor must it be regarded as proof that packages of these brands purchased subsequently will meet the requirements.

Guarantees of these conditions must be supplied by the individual manufacturers.

Undoubtedly, all investment manufacturers having proper testing facilities and accurate control of manufacture will immediately take steps to guarantee their products.

The profession will, in this manner, be able to select investment materials which are suitable for use in the production of accurate restorations.

OPERATIVE DENTISTRY FOR THE CHILD*

By A. D. A. MASON, D.D.S., F.A.C.D., Toronto, Canada

POSSIBLY the most important problem confronting the dental profession at the present moment is the subject of operative dentistry for the child. To my mind, the future status of dentistry rests on the manner in which the dentist approaches this problem, and its solution.

Dentistry will take its rank in accordance with the amount of service which we can render to society. When can we be of greater service than at the time of development of dentition?

Granting the importance of dentistry to the adult: it does not compare with or have the far-reaching effects of service rendered to those of tender years. It is from the point of view of the general practitioner that I wish to approach this subject rather than from that of the specialist, since it is only through the efforts of the whole profession that this problem can be satisfactorily solved.

Let us first make a survey of the conditions under which we practice modern dentistry; in other words, let us consider factors influencing procedures in practice today: 1. The problem of focal infection, which has changed our whole attitude in rendering health service to the public. 2. Prevention in dentistry, superseding reparative procedures. 3. Systematized prophylaxis and mouth hygiene. 4. Effects of diet on dentition and preservation of the teeth. 5. The prevention and the management of developmental defects of the crowns of teeth (pits and fissures). 6. The damaging effects of early extraction of children's teeth (both deciduous and first permanent molars). 7. The tendency either from heredity, evolution or whatever cause to irregular development of the arches. 8. Prenatal care of the mouth. 9. Control of habits of children (breathing; tongue, lip and cheek sucking; habits of sleeping). Extension for prevention of caries as a principle does not carry such significance as formerly.

I should like to make one further observation. What does a patient expect to be told when consulting a dentist? Is it that some damage already done should be repaired? Or that resultant conditions ten or twenty years hence will produce definite pathologic effects of a more serious nature? Looking at the child problem from this point of view, what are we as general practitioners of dentistry going to do for these children?

Children in the immediate past, and even today, are being neglected by the general practitioner. This is evident from the fact that a new specialty has arisen within the field of dentistry. I refer to pedodontia.

The dentist who neglects the children of the family may possibly, and I might

*Read before the Section on Operative Dentistry at the Midwinter Clinic of the Chicago Dental Society, Jan. 15, 1930.

venture the prediction, will, toward the last third of his professional life, find patients scarce and practice dwindling. You cannot keep mothers as patients and neglect the children. Children are the adult practice of ten years hence.

In which dentition can we accomplish the most lasting results from our efforts? Surely, in the deciduous dentition. We can place a filling in a child's tooth which will last the life service of that tooth, say two or three years, more easily than an inlay in the tooth of an adult, which will be expected to give service for fifteen or twenty years.

What joy and satisfaction we experience if we have been successful in some simple regulation of the teeth, or through our instruction and effort have produced a beautiful and efficient secondary dentition for a grateful patient. These rewards count for more than money, although, of course, financial returns are generally the accompaniment of honest service.

As operators, how do the majority of the dental profession approach this child problem? Possibly from the standpoint of the eruption of the first permanent molar. If, as a profession, we are able to have this tooth erupt and remain in its proper position through adult life, we will have accomplished something worth while. What is happening in so many cases today? The development of this tooth in malposition, and its premature loss through caries and extraction of its roots.

What can be done to guide the first permanent molar into its proper place? Today, through ignorance, deciduous teeth are being unduly sacrificed by the medical profession, influenced by the factor of focal infection, and the dental profession is not rising to its obligations. Both professions are advising extraction of deciduous teeth, and first permanent molars also, to such an extent that, it seems to me, they are creating more infection than is being eliminated. If treatment by extraction today at 7 or 8 years of age produces an irregular second dentition and many pyorrhea pockets with their accompanying pus at 40, what is being accomplished? I am not advocating retention of infection. If there are men here today who believe in the removal of all infected deciduous teeth in an effort to eradicate every vestige of infection, my suggestion to them is: Do not feel that you have accomplished much after these extractions. Do not extract without thinking of "the sequel." Do not say "goodby" to your patient, thinking you have reached a final solution of the problem. You have only started something.

Exhaust every effort to retain these deciduous molars and, if you fail in this, the whole story of space retention is open for your investigation and application.

We can extract adult teeth and, if no further treatment is given, nothing results but edentulous spaces. Not so with children; Nature provides for other teeth to erupt, and it is our duty to the child to see that they erupt in their proper places, or at least have a chance to do so. It is the duty of every one interested in the health of the rising generation to do something more than destructive work. Anyone can tear down and destroy tissue. Let us be constructive.

What means have we at our disposal to retain the first permanent molar in its proper place?

1. *Prenatal Care.*—This is possibly the most important step in the treatment. Some may feel that it is in the province of medicine only. This may be true, but this fact does not offset responsibility of the dentist. It takes the combined efforts of both professions to cope with the prob-

lem. Let us cooperate and work in harmony with the medical adviser. These prospective mothers should at least receive some instruction from the family dentist. The pedodontist cannot reach them. The general dental practitioner has the confidence of the parents. Does it not hurt when a mother says, "If I had only known."

The diet of the expectant mother is the means of treatment, and this includes not only the varieties of foods, such as carbohydrates, proteins, salts, fats and vitamins, but the amount of food, time of eating, amount of water consumed, exercise, elimination and rest. Just a word regarding the much-used term "balanced diet." This is an equation that differs as to patients. It is a variable problem in the same patient under varying conditions, such as heredity, age, occupation, physiologic conditions (pregnancy) and pathologic conditions. Do you realize what a very slight change in a patient's diet really means? The withholding or giving of a very slight amount of the proper food will bring about definite change.

I would suggest the following instructions to prospective mothers:

1. Sugars and highly sweetened foods should be used very sparingly—the less, the better.

2. Bread, grain and flour products should be used in moderation. Of this group, the whole grain product is much to be preferred to the white flour product. Pastry, cake, etc., should be avoided.

3. The less starchy vegetables, fruits and greens should be taken liberally. Some raw or uncooked fruit and greens should be eaten every day. Acid fruits should be eaten only in the early part of the day. The uncooked greens may be eaten any time.

4. Protein foods — meat, fish, fowl, eggs, cheese, milk, peas, beans, etc. — should be taken moderately.

5. Fats—butter, cream, meat, fat, etc. —should be taken moderately.

6. Thoroughly masticate and incorporate all foods with saliva.

7. Avoid overeating or eating late at night.

8. Regular daily physical exercise of a generous nature should be taken, some out-of-doors. Maintain poise of mind by self-control and a real interest in work, recreation and rest.

In the second place, it is well to urge a check-up every three months. Even the most intelligent patients forget or perhaps do not quite grasp all of your advice on the first visit, and a further chat over the matter fortifies them in the carrying out of your instructions.

The eating of plenty of greens grown in the sunlight and its effect in keeping high the calcium index in the body and what that means both to mother and child, interests all expectant mothers.

In the last place, we can point out that, after parturition and when nursing begins, this same régime of living will give to the nurse the elements requisite for normal development of the child until weaning takes place.

When the foregoing advice is followed, we find that not only is the young human being off to a good start, but also the mother has come through the experience without caries or gingivitis, and, further, has become educated in the matter of healthful living, so that she can carry on with benefit not only to herself but to those over whom she has the care.

2. *Treatment of the Child.*—The second period of treatment for children is during infancy, possibly up to 3 or 4 years of age. During this period, the child comes more under the guidance and ob-

servation of the medical practitioner. The only contact the dentist has is through the medical practitioner or the parents. Often, before the dentist is consulted, cavities appear in the teeth.

Diet, prophylaxis and hygiene are the best and almost the only measures to control caries at this period. Far more important than this fact, the calcification of the second dentition is taking place. From birth, or earlier, up to and during the first years of life, calcification of the second dentition is taking place. During the first year, we have the development of the central and lateral incisors, molars and cuspids. This is the only opportunity to control these pitted and poorly developed teeth, which are so common at the present time.

At the age of 4 or 5 years, the patient comes under the direct control of the dentist, and remains so through life.

If we have failed in the first attack on the problem (that is, by prenatal treatment) and developmental defects do appear, we have pits and fissures to treat. Let us act promptly. Great care must be exercised to recognize such conditions in their incipient stages. Dentistry has passed the time of waiting for cavities to develop. Pits and fissures should be cut out and filled before we have the loss of dentin. The amount of dentin in deciduous teeth is so small that we cannot afford to lose any. Therefore, it is best to eradicate these defects early. By pits and fissures I mean pits and fissures, not sulci. This close observation and retention of the deciduous molars will decide the location of the first permanent molar, thus giving the patient a fair start with the second dentition. If proximal cavities have developed, fillings must be inserted in order to retain the pulps in a healthy condition so that the roots of these teeth will be absorbed naturally and the permanent teeth guided into proper position. If in the deciduous teeth, the pulps and roots have been retained in a healthy condition, separation of these teeth naturally, takes place, and there is no necessity for building out contact points on proximal fillings. Further treatment of developmental defects in deciduous teeth —medication of teeth with silver nitrate, metaphen, resorsinol, copper cements— without cutting can be resorted to and are most helpful at this age.

Restorative Measures in Deciduous Teeth. — We are now faced with the problem of making restorations in the deciduous teeth. The following materials have been found most suitable for this purpose: gold onlays, amalgams, both silver and copper, and the cements, both copper and oxyphosphate of zinc. Possibly, the order in which the materials have been named will classify them as to importance. Of course, early diagnosis would have a bearing on the material selected. Pits and fissures of deciduous molars can be filled best with amalgam. When they are filled early, the preparation is not so painful and the plastic material is more easily inserted. If caries is extensive on the proximal surfaces and a considerable loss of dentin is involved, a combination of cement and the gold inlay will give the best results. In these cases, it is almost impossible to get retention in the small amount of dentin without exposing the pulp; therefore, gold is a material by which we can preserve the pulps. The cavity is filled with cement and retention obtained for the gold on the external surface of the enamel. The decalcified dentin can be removed with hand curets with a minimum amount of pain. The lost dentin can be replaced with cement with the slightest amount of retentive form, and the whole can be bound together with the gold onlay. If

preparation is made in the nonsensitive enamel and the actual cutting is done with a knife-edged stone, we will experience less objection from the child.

I am aware that gold for this purpose may be out of the reach of many patients, but it is our duty at least to give the patient the privilege of making the decision. You may be surprised at the results.

Retention of Spaces. — Why the importance of this provision? If in our zeal to eradicate infection, we have lost deiduous molars or cuspids, it is imperative that the spaces for the secondary bicuspids and cuspids and the position of the first permanent molars be maintained. This opens a big field of endeavor which today is being neglected, and is a problem the solution of which must be accomplished by the general practitioner.

Space retainers can be made and cemented in position, treatment thus being carried into the field of preventive orthodontia. Improvements in methods of casting have simplified the construction of these appliances as well as the construction of onlays.

Retention of interproximal spaces: When the secondary tooth has commenced to absorb the roots of the deciduous tooth, we need not worry about retaining these spaces. The erupting tooth does that. The bridging of these spaces under normal eruption is detrimental rather than beneficial. All that is necessary when a restoration must be resorted to is to maintain the mesiodistal measurement of the deciduous molar. Is it permissible to leave open deciduous roots to help retain the position of the first permanent molar? Under unfavorable conditions, I would not do so, but when conditions indicate a good family history, high resistance in the individual child and good cooperation (and at times the financial factor is to be considered), we are justified in following our judgment and deciding to leave a root in position for a short time. This may not be looked on as ideal treatment considering the immediate local conditions, but looking toward conditions at adult life, we may be eradicating many pyorrhea pockets.

If we have now succeeded in having the first permanent molar well developed, and it has taken its key position in the arch, the future is bright. Many secondary molars and bicuspids will develop with pits and fissures defective, atrophic enamel and enamel lacking resistance to caries. Then, the period of puberty is a most trying time on the dental organs. At this period, parental control is relaxed, and the dentist must exercise renewed vigilance, resorting again to education of the patient regarding diet, prophylaxis, hygiene, etc.

Early diagnosis of caries and periodontoclasia cannot be stressed too much. The most minute survey of the dental organs, based on general conditions, is imperative. Magnifying mirrors and glasses are used to scrutinize the tooth and gum surfaces. With the finest of explorers, search is made for developmental defects. Roentgenography is employed to discover incipient caries, and one's practice is made pleasant through the discovery and repair of conditions at a time when simple measures are applicable.

IMPORTANCE OF ROENTGENOGRAPHIC EVIDENCE IN BONE CHANGES AFFECTING DENTURE STABILITY*

By HOWARD H. JACKSON, D.D.S., Detroit, Mich.

IN a symposium on balanced occlusion, one of the essayists made the following comprehensive statement: "The duration of denture service depends on the permanence of the supporting structures." This concise statement invites the following questions: 1. What are the causes of unstable ridge forms? 2. Is there not some index by which unstable and favorable types can be determined with reasonable accuracy? 3. What measures are apparently indicated to overcome unstable ridge forms? 4. What measures can be taken to insure permanence of the favorable ridge form?

The desired type of ridge form, and one which we usually regard as permanent, is broad, well-rounded soft tissues, with muscle attachments in such position that there is no interference with the margins of the dentures. Roentgenographically, the cortical layer is dense and uniform, with no sharp edges or spurs. The cancellous structures are laid down in accordance with the laws of mechanics to support the cortical layers against the stresses of mastication, as has been so ably shown by MacMillan. They are uniform in density from the cortical layer to the mandibular canal, and the spaces between the trabeculae are small. Unfortunately, not all cases present this picture, and these are the ridge forms noted in the unstable cases.

There are three causes of unstable ridge forms. The first two of these are directly within our control. One is the result of failure to apply the laws of mechanics during construction of the dentures, so that balance is not obtained. The second cause within our control is that the arches have not been properly prepared by the surgeon at the time of the removal of the teeth. The third cause is largely beyond our direct control and has been most lucidly stated thus: "The presence of artificial dentures is nearly always evidence that the patient has been improperly nourished." The prosthodontist of today recognizes the fact that the loss of the teeth is usually due to systemic disturbances affecting the teeth and their supporting structures; that this disturbance of the body mechanism can be characterized as a process which extends over a period of years and affects the parts in question but slowly; that the removal of the teeth does not correct the atrophic process, when the systemic condition is the underlying factor, but that, instead, the same influences will still be present and will affect, in varying degrees of severity, the successful outcome of his endeavors. The prosthodontist is as much interested in the causes of the loss of the teeth, in the causes for changes in the supporting structures beneath tissue-borne pieces, and

*Read before the Section on Full Denture. Prosthesis at the Seventy-First Annual Session of the American Dental Association, Washington, D. C., Oct. 8, 1929.

in the possibility of the prevention of such changes, as he is in the problems involved in the construction of the denture itself.

The third group of causes of unstable ridge forms can be subdivided into two classes of change, the first being that which is recorded in or adjacent to the ridge itself; and the second, that in which there is evidence of alteration of the cancelli themselves throughout the entire picture, so that the necessary support is not furnished the outer plates. The first is usually caused by improper surgery, the incomplete removal of the osteolytic agents, such as retention of marginal sacs, which affect the cortical layers and cancelli. The second deals with the character of the cancelli as a whole. Both of these subdivisions can be used as the index of the stability of the ridge form.

Each individual has a cancellous registration which is characteristic of himself. In considering the cancelli as affecting the permanence of the ridge form, we must remember that these structures are subject not only to mechanical influences but also to the same systemic influences within the body as affect the bone-salt metabolism and that these influences were instrumental in loss of the teeth themselves, traumatic influences excepted. As Percy R. Howe has stated: "The careful adjustments which are necessary in a solution designed to promote cell life outside the body ought to suggest to us that somewhat similar care should be employed in producing serum which is to bathe the cells within our bodies."

If the disturbed metabolism was sufficient to produce caries or periodontoclasia, we can justly inquire as to why these same conditions will not be manifest in the bony structures themselves. We believe that such is the case. We know that the roentgenographic registration of the cancellous structures is characterized by uniformly irregular spaces between the trabeculae and that these are recorded in varying degrees of density and with great variation in appearance. In some instances, there is a dense cortical layer with but little evidence of cancellous formation. In other instances, the reverse is true. In other cases, increased dosage of the rays is necessary before a distinct registration of the roots of the teeth can be observed. In a normal individual, there will be an increase in the number of the cancelli about a tooth standing alone, as a response to the stress of mastication.

Many cases can be shown of isolated teeth striking against opposing teeth without increase in the density of the surrounding cancelli. Therefore, the mere increase in the density of the cancellous structures cannot be considered as evidence itself that it is in response to stress and stress alone.

Observation of cancellous formations will afford instances of generalized increase in the number of the trabeculae over that usually observed, the breadth or thickness of which is not nearly so great as usual. In other instances, there is a marked thickening of them without decrease of the number, so that the spaces are greatly diminished in size. Why, in some instances, are the vessel channels shown distinctly, and why, in these cases, are they usually if not always associated at a later period with the recurrent types of knife-edge ridge formation? Why are the spaces between the trabeculae in the recurrent type of knife-edge ridge larger by far than are normally observed? In still other cases there is a rounding of the spaces. Why is this so? We do not know as yet, but observations have been made which warrant us in the assumption that it is largely the result of changes in the metabolism, either from

faulty diet or disturbed endocrine functions, or both.

There are two methods of observation, one dealing with laboratory experimentation and the other observation of characteristics in the patients themselves. I mentioned this subject several years ago, and, since that time, we have been attempting as far as possible to correlate the types of cancellous change with the systemic conditions of patients. We are not ready as yet to present a preliminary report based upon case histories and accompanied with the roentgenograms of the cancellous structures, but we are far enough advanced in two lines of the study to have more than a hypothesis. A certain type of cancellous registration is almost positive evidence of a hyperactivity of one of the ductless glands and a hypofunction of the other. In this instance, we note a most unusual condition in that there are apparently diametrically opposite physiologic actions occurring at the same time. In this, we note a thinning of the cancellous structures, so that they are diminished in size and in number, accompanied by a deposition of adventitious dentin within the chambers to such an extent that slow loss of vitality of the pulps will result. We also know that a certain type of registration of the structures in the floor of the antrum is associated with a renal disturbance, and only with one phase of renal disease. Percy R. Howe has shown that the mere change of vitamin A intake could alter the cells so that odontoblasts became osteoblasts, and observations of like character can be cited by all research workers. A study of the work of Jones and Simonton will give one an inspiring idea as to the possibilities of the use of the intra-oral roentgenograms in determining the effects of dietary and endocrine disturbances on the teeth and the crests of the septums. It also inspires one to continue the work of investigation on patients. In this work, there had been such a change that roots of a dog's tooth are showing absorption and the crests of the septums are broken down. If this can occur in the animal, it should likewise occur in the human being, and apparently it does, but in a less marked degree.

The dental roentgenogram is the sole means of determining these changes during life. Roentgen-ray diagnosis can be made a fairly accurate exact procedure if the dentist can be taught to interpret his findings in terms of pathology which he can correlate with his clinical findings and explain on a reasonable basis. He must learn to recognize in the film the structural changes in the tissues about the teeth produced by pathologic processes as compared with the normal, considering them as shadowgraph projections comparable with a cross-section of a similar pathologic area if examined under the microscope, but a superimposed shadow picture of all the areas through which the rays have passed. In order to employ the rays to determine the character of the cancellous structures, we must make use of those roentgenograms that are interpretable; that is, the soft tissues must be distinguishable and the enamel cap must be distinct, with a minimum of distortion of length and breadth of the objects registered thereon. This study is too extensive for any one individual; and we can give but an outline of its future possibilities. The time is coming when the competent internist will be aided by observing dentists in the early determination of those disturbances which affect bone-salt metabolism. It is this phase of roentgenographic interpretation that will help the prosthodontist in the preservation of favorable ridge forms.

DISCUSSION

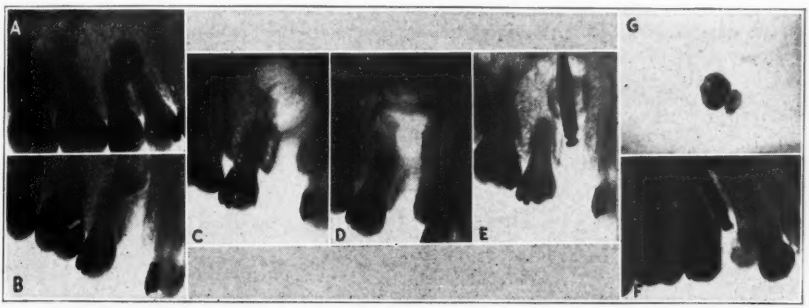
Clarence O. Simpson, St. Louis, Mo.: This interesting paper presents observations and theories which could be discussed at length, without reaching a definite conclusion. In considering denture support, favorable ridge form can be distinguished by ocular and digital examination, and favorable alveolar structure can be demonstrated by radiodontic examinations. When conditions are rendered unfavorable by irregularities of the alveolar crest, retained root fragments or diseased areas, they can be improved by judicious surgical treatment. When the attachment of the teeth has been destroyed by a rapidly progressive periodontoclasia, and the character of the bone is such that the alveolar process continues to atrophy after the removal of the teeth, there is little to be done in control or correction. In seeking the explanation for different types of bone structure, hereditary influence should be considered. There is a tendency, in pursuing theories, to disregard collateral evidence which interferes with preconceived ideas. Inherited characteristics are difficult to exclude but are easy to ignore when they inject an element of doubt into the accuracy of the conclusion. A great many data are required to differentiate the effect of diet and that of function on bone structure. Dietary deficiencies must be marked to affect the entire skeleton, but functional stimulus regulates regional bone development. The problem is rendered more intricate by the apparent influence of the endocrine system. Assuming that a defective metabolism is responsible for the unstable ridge form and structure, the remedy is not readily applied. Improvement in metabolism is more easily secured in childhood and young adult life than later. Even if metabolism is corrected, little structural benefit could be expected at an age when regenerative powers are impaired. A consistent application of the theory would be the preparation for ridge stability, prenatally and in childhood and youth, by maintaining metabolic equilibrium. Then, if metabolism is the decisive factor in dental conservation, the teeth would not be lost and artificial dentures would not be needed. This dental millennium would be a happy solution of the problem. Dr. Jackson states that pulp degeneration and a certain type of bone deficiency are almost positive evidence of hyperfunction of an endocrine gland accompanied by a hypofunction of another; also, that a certain type of structure in the floor of maxillary sinuses is definitely associated with a phase of renal disease. For some unexplained reason, he withholds this important information. The emphasis on the necessity for clear roentgenographic evidence and earnest study of it is appropriate. Radiodontia offers a much more extensive field of service than is usually obtained. Dr. Jackson is to be commended and encouraged for his investigation along lines about which knowledge is lacking. However, he should fully report his observations and opinions for verification or correction.

TOOTH IN UPPER LIP: REPORT OF CASE

By C. L. RION, D.D.S., Seattle, Wash.

MRS. R. R., an American, aged 30, was referred because of the possibility of some connection between an iritis and the oral condition. The accompanying roentgenograms were taken as the examination progressed. *A* reveals an acute pericementitis of the right upper second bicuspid, with the first bicuspid in normal position, but apparently a supernumerary bicuspid crown present, the roots of which, if any, extended toward the palate. *B*, taken as a check-up when no tooth could be found on operation, showed the crown in the same position. In the third film taken, *C*, the crown had disappeared. *D* shows that the crown has taken an apparently impossible position. *E* was taken after a bur had been placed as a check. Again, the elusive crown is seen, but it was not found when the exploration was continued. In *F*, it has taken up still another position.

At this point, and after operations had been continued for an hour and fifteen minutes, the patient's husband called attention to a hard lump in the upper lip near the vermilion border. *G* reveals the bicuspid crown, with a smaller one, in the lip just above the vermilion border.



Roentgenogram *(A)* revealing apparent presence of a supernumerary bicuspid crown, and subsequent roentgenograms *(B-F)* taken in an effort to locate and remove it. *G*, crown, with smaller one, found in lip.

In thirty years' experience, I have never seen a tooth so far out of its natural environment.

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C. N. JOHNSON, Editor

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Editorials

AGAIN THE CHRISTMAS SEALS

About the time this issue reaches our members, the Christmas Seals will be on their mission of mercy and deliverance. Each year, the response from the seals is encouragingly larger—to the honor of our members—as also is the increase in appeals for aid. The appeals must inevitably grow greater in the natural order of things, and thus we must strive in every way possible to build up the Relief Fund, so that we may promptly meet every legitimate demand made on it. If our members could only see the letters that come from those who are assisted, or from the members of their families when the beneficiaries themselves are unable to write, it would warm their hearts and loosen their purse-strings. There is something so uplifting and stimulating in the mere fact of helping others who are unfortunate enough not to be able to help themselves that the wonder is that more of our members do not avail themselves of the privilege of contributing to the fund through the

medium of Christmas Seals. There is no member of our organization who cannot afford to contribute at least one dollar in every year to the alleviation of the ills of his fellowman, and if everyone did that, it would soon build a fund that would be outstanding in philanthropy.

Some of our states are doing nobly, and it has been suggested that we publish the per capita subscriptions of the different states:

PER CAPITA SUBSCRIPTIONS TO THE RELIEF FUND
FOR THE YEAR ENDING JUNE 30, 1930

State	Average Per Member
Alabama	$0.33
Arizona	.53
Arkansas	.22
U. S. Army	.13
California	.66
Colorado	.63
Connecticut	.75
Delaware	.31
Washington, D. C.	1.01
Florida	.31
Foreign	2.33
Georgia	.25
Idaho	.33
Illinois	.54
Indiana	.35
Iowa	.47
Territory of Hawaii	.29
Kansas	.33
Kentucky	.34
Louisiana	.32
Maine	.40
Maryland	.39
Massachusetts	.42
Michigan	.35
Minnesota	.34
Mississippi	.23
Missouri	1.09
Montana	.44
Nebraska	.23
Nevada	.11
New Hampshire	.81

State	Average Per Member
New Jersey	.49
New Mexico	.38
New York	.77
North Carolina	.15
North Dakota	.40
U. S. Navy	.07
Ohio	.48
Oklahoma	.24
Oregon	.51
Pennsylvania	.57
U. S. Public Health	.06
Philippine Islands	1.00
Rhode Island	.46
South Carolina	.13
South Dakota	.19
Tennessee	.37
Texas	.36
Utah	.35
Vermont	.26
Virginia	.34
Washington	.24
West Virginia	.27
Wisconsin	.39
Wyoming	.37

It is true that the measure of loyalty or charity is not gaged by the amount of individual contributions, but it surely must be a source of pride and satisfaction to a state when its members record a one hundred per cent response. And here is a suggestion: In the past it has been the habit of some of our members to contribute more than one dollar so that the average might be maintained in case there chanced to be certain members who felt that they could not make any response to the appeal. What a fine opportunity this is to show loyalty to one's state and to bring warmth to one's heart! The suggestion is here made that all of those who can afford it should send in five, ten, or—as one member of the relief commission suggests—one hundred dollars, to raise the general quota sufficiently to make it representative of the loyalty and generosity of our best men. The good that is accomplished by this fund con-

stitutes it as one of the really worthy philanthropies of professional life, and our Association can bring to it no greater honor, nor more outstanding achievement, than to build this fund to such proportions that relief is placed on a permanent basis, and is capable of caring for any emergency that may arise. Think this over and search deep in your heart for its most abundant and spontaneous impulse, and act in accordance therewith.

Last year, the Editor received many letters about the seals that were significant of the best there is in our profession. One member wrote a long letter which was like honey from heaven itself. He marveled that there could be the least hesitation on the part of anyone to contribute his mite. He had never missed sending a contribution, and a check accompanied his letter, even though he and his wife had been in the hospital under heavy expense for operations, hospital expenses and other incidentals which absorbed a year's income. The spirit in which his contribution was sent carried with it the sweet savor of helpfulness and generosity and it typified the rarest impulses of our common humanity.

Another letter was from a man who had practiced dentistry for fifty years, and was approaching blindness, yet he cheerfully sent his check. Neither of these men has ever applied for relief.

The beautiful Christmas time, of all the year, seems the most appropriate and opportune in which to dispense charity and good will. The hearts of men more naturally expand at this season than at any other. It is the season of the family fireside, and around it cling the tenderest memories of our civilization. If a man's heart cannot respond to an appeal at such a time as this, there is not within it the element of happiness, because true and abiding happiness comes only from "doing good and being kind."

Let us all unite to make this a joyous Christmas even with the cloud of financial depression hovering over us. If the depression is hard on us, it is infinitely harder on those who are suffering and in want, and a little self-sacrifice on our part will paint a different picture for our profession and the world to look at. It is absolutely necessary that we maintain this philanthropy, and to do so in its

highest efficiency, we must have a whole-hearted response on the part of everyone.

A suggestion has been made several times by those who have had occasion to observe the great benefit resulting from the Relief Fund, and who have witnessed the constant effort necessary to build up the fund, to the effect that the dues should be increased to take care of this really necessary charity, but how very much better it is to raise the money by the spontaneous, voluntary generosity of our members, and let it come as a gracious offering on their part. It surely warms the heart of every man or woman who contributes to the relief of needy fellow members in this way, and the spirit behind the gift is a twofold benefit—it sanctifies the giver as well as the beneficiary. There is no need of raising the dues; it is better to accomplish our purpose in another way. Let us all help, and make each other happy.

THE INSURANCE PLAN

Many enquiries have been received at the Central Office regarding the group insurance plan inaugurated recently by the American Dental Association on behalf of its members. We have not the precise figures to date, but about November 1 there had been received since Jan. 1, 1930, 42 death claims from 19 different states. This represents a total of $108,000.00 that has been paid to the families of members through this medium, which should demonstrate without question the desirability of this enterprise. We do not know how much has been paid in to the companies in the way of premiums, but the principle of life insurance in general has so well been demonstrated that it should need no argument in its favor, and group insurance would seem to be the most desirable of all forms. In this instance at least, it is working admirably, and we have heard of no complaint on the grounds of lack of promptness, or of hesitation in the settlement of claims. It is a form of protection which should appeal to the good judgment of every eligible member.

ARE WE AN INTELLECTUAL PEOPLE?

Someone has said that the average expenditure per person in America for candy, ice cream and confections is $18.15; and for books $1.10. Of course, no one can positively state that books are better for people than sweets, and as a matter of fact if it came to the question of sustaining life it is likely that candy might do it for a longer period than books; but that does not mean that the ratio of expenditure is sane or logical. Life is something more than mere physical existence, and in the end the individual or the nation that ignores or neglects intellectual development will reap the harvest of deterioration and decline. We do not live by bread alone, and those who are to get the most out of life must cultivate some of the higher qualities of our existence and let the material needs prove merely an adjunct.

After all, sweets as we find them in candy are no more a necessity of life than are books, and their too liberal use is a mere pampering of taste, in other words an indulgence. The taste of sweets is evanescent and soon gone, but the atmosphere of a good book lingers with us and in fact it may color and form our whole life. Let us be logical and buy more books and fewer sweets.

VICTOR HUGO FUQUA, D.D.S.

(1870-1930)

Victor H. Fuqua was born in Hopkinsville, Ky., Feb. 20, 1870. He died Oct. 30, 1930, of pneumonia.

Dr. Fuqua was educated in the grammar and high schools of Hopkinsville and entered the office of A. W. Eldridge, Big Rapids, Mich., about 1891. He moved to Streator, Ill., where he practiced with C. R. Taylor. In 1894, he moved to Shelbyville, Ind., where he associated himself with J. A. Bowman. From there, he went to Louisville, Ky., where he stayed for a short time. He then returned to Illinois and located in Chicago, where he practiced till his last illness. He was a graduate of the Chicago College of Dental Surgery. He joined the Illinois State Dental Society in 1899, and was, therefore, a life member. He was past president of the Chicago Dental Society, and a member of Delta Sigma Delta Fraternity.

In 1901, he married Grace D. Williams of Pittsburgh, Pa., who, with their daughter, Hortense, survives. He leaves also three brothers and one sister.

Interment took place in Tennessee.

COUNCIL ON DENTAL THERAPEUTICS

PYROS—NOT ACCEPTABLE FOR A.N.D.R.

The Council has authorized the publication of the following report:

SAMUEL M. GORDON, *Secretary.*

PYROS was submitted to the Council by the Pyros Company, Denver, Colo., successors to The Rhea Chemical Company. According to the Pyros Company, Pyros is made up as follows:

Water, 1 gallon (1,000 c.c.)[1]; potassium permanganate, 11 grains (0.199 gm.); copper sulphate, 11 grains (0.199 gm.); zinc sulphate, sufficient to give gravity indicating 65 per cent salt; sodium chlorid, sufficient to give gravity indicating 95 per cent salt; alum, 20 grains (0.343 gm.); hydrastis, 10 grains (0.172 gm.); sulphur, 60 grains (1.029 gm.)[2]; glycerine, sufficient to moisten the sulphur when the latter is added to the other material; oil of wintergreen, 4.29 grains (0.0738 gm.); alcohol, 60 grains (1.029 gm.); saccharum, a sufficient quantity to color the foregoing compound.

As such, it represents an example of a crude "shotgun" mixture made with little attention to pharmaceutic elegance or an appreciation of the treatment of the diseases in which it is stated to be useful. Its use as such cannot be condoned by progressive dentists.

The carton is labeled "Pyros for Pyorrhea." It is claimed to be "a perfect antiseptic," but no evidence to support the claim was submitted. Elsewhere on the carton is the statement: "a remedy for sore, loose, tender or ulcerated gums and pyorrhea infections generally."

The main label attached to the bottle bears no reference to pyorrhea, which naturally leads one to wonder if the Food and Drugs Act, as amended, did not act as a deterrent.

The claims in the circular which accompanies the bottle are not so conservative.[3] Statements such as, "Good health depends on mouth health," are written in such manner as to give the impression that "Pyros makes healthy mouths." It is claimed

1. One gallon is equivalent to approximately 3.8 liters.

2. Approximately 15 grains is equivalent to 1 gm.

3. The Council desires to call the attention of dentists to the fact that the Food, Drug and Insecticide Administration of the United States Department of Agriculture exercises no supervision over statements made in advertising matter aside from the principal label. Dentists and the public should be guided only by statements appearing on the label.

that "Pyros penetrates" because it "has a peculiar penetrating action so that it even attacks deep, underlying, inflamed conditions" and "Pyros makes clean, healthy saliva, nature's mouth wash." The fact that no evidence is submitted to substantiate these claims puts them in the realm of fancy. Directions are given for the use of Pyros in pyorrhea, trench mouth, ulcerative gums, tender gums, bleeding gums, spongy gums, turgid gums, offensive breath or nauseating odors, irritation due to wearing false teeth, removal of tartar, soreness due to crowns and bridgework, after extraction and as a daily mouth wash. In the light of the declared composition, all of these claims are without rational basis and are therefore not only unwarranted, but also decidedly unscientific. The following direction is particularly offensive, "Mothers, teach your children the Pyros habit early in their lives. It will save you endless dental and medical expense and many anxious hours. It is an excellent preventive."

Directions as to "How to Prevent Decay of Teeth at Home" by the use of Pyros are given. In the light of the declared statement of composition for Pyros, it is not easy to see how it will prevent decay of teeth.

The Council declares Pyros inadmissible to A.N.D.R. because it is an unscientific and carelessly compounded "shotgun" mixture for which unwarranted chemical and therapeutic claims are made; and because it is advertised to the public in a manner which does not react to the interests of the profession and the public; because directions for self-treatment of serious dental diseases are given, and because of the objectionable name. Its composition and advertising statements are distinctly unscientific, and have no place in A.N.D.R.

KEMOZONE—NOT ACCEPTABLE FOR A.N.D.R.

When the report of the Council below was transmitted to Kemozone, Inc., they submitted a lengthy reply, stating that they do not claim that Kemozone is chinosol, although the fact remains that Kemozone is another copyrighted name for normal oxyquinolin sulphate, which for years has been recognized by the medical profession under the name of chinosol. Exceptions were also taken to the statements of the Council regarding the germicidal claims made for Kemozone; that Kemozone, Inc., is not entitled to a proprietary name for oxyquinolin sulphate, according to the Council's rules, and the statement regarding the advertising of Malt Zyme Products. Inasmuch as Kemozone, Inc., offered no acceptable evidence regarding objections of the Council, and no new evidence to support the claims for the product was submitted, the Council voted to confirm the nonacceptability of Kemozone for A.N.D.R. and authorized publication of the following statement.

SAMUEL M. GORDON, *Secretary.*

Kemozone, according to Kemozone, Inc., Long Island City, N. Y., is normal oxyquinolin sulphate (chinosol). It is marketed as Kemozone solution, a one per cent solution of normal oxyquinolin sulphate in water; and as Kemozone tablets, each containing three-quarters grain (0.05 gm.) of normal oxyquinolin sulphate.

The evidence offered in support of the application of Kemozone for inclusion in Accepted Nonofficial Dental Remedies, in the main, is that well known for oxyquinolin sulphate (chinosol), which, for a number of years, has been included in the book, New and Nonofficial Remedies of the Council on Pharmacy and Chemistry. Beyond

statements quoted from current textbooks on dental materia medica oxyquinolin sulphate, no evidence is offered to show the advantages of Kemozone over the accepted nonofficial article. Furthermore, no evidence is given by the proprietors to support their right to a proprietary name for a well-known nonofficial preparation. The multiplicity of names for common substances, the Council holds, is not in the interests of the profession and the public.

The claim that normal oxyquinolin sulphate has been recently introduced into dentistry in tablet form under the name of Kemozone is not warranted by the facts. Chinosol was introduced into dentistry as far back as 1895 by Grunert, and its properties are well known.

It is stated that Kemozone is not advertised directly to the public. However, each trade package contains a circular, which carries recommendations for the lay treatment of a number of conditions. On the whole, the recommendations do not seriously conflict with the provisions of the Council on direct advertising to the public (Rule 3).[1] The advertising, however, frankly states that Kemozone is germicidal. This statement is unwarranted in the light of knowledge as to the antiseptic properties of chinosol, a feeble germicide, weaker than phenol and much weaker than mercuric chlorid. The advertising is in serious conflict with Rule 4,[2] that which makes the dentist an advertising medium to the public.

Each trade package contains advertising on Malt Zyme Products, which at different times have been the subjects of reports by the Council on Pharmacy and Chemistry of the American Medical Association. Such advertising is contrary to the Council's attitude that no article will be accepted or retained in Accepted Nonofficial Dental Remedies if it is used to advertise a product not acceptable to this Council. In view of the reports on Malt Zyme Products by the Council on Pharmacy and Chemistry, unless the conflicts mentioned by the Council on Pharmacy and Chemistry are removed, such products, or products advertised in connection with them, remain unacceptable to the Council on Dental Therapeutics.

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1. Rule 3.—Direct Advertising.—No article that is advertised to the public will be accepted or retained, but this rule shall not apply to (a) disinfectants, germicides and antiseptics, provided the advertising is limited to conservative recommendations for their use for oral hygiene purposes; and provided they are not advertised as curative agents, either directly or inferentially (see comment to Rule 3); (b) dentifrices (toothpastes and powders) which act as mechanical agents in the cleansing of the teeth; provided, of course, no such agent is known to contain harmful materials and none of the lay advertising is contrary to the Council's attitude on dentifrices; (c) other prophylactic agents about which the public should be informed which would not lead to harmful self-medication provided (1) they are not advertised as curative agents and provided (2) advertising does not go beyond that passed by the Council for dentists (Rule 6); and (d) medicinal foods, except when advertised as curative agents.

2. Rule 4.—Indirect Advertising.—No article will be accepted or retained if the label, package or circular accompanying the package contains the names of diseases, in the treatment of which the article is said to be indicated. The therapeutic indications and properties may be stated, provided such statements do not suggest self-medication. Dosage may be indicated. (This rule shall not apply to remedies with which self-medication is altogether improbable.)

Statements appearing in the lay advertising as follows

Kemozone is a strictly chemical substance that has been thoroughly tested and approved both here and abroad by leading chemists, surgeons, physicians and dentists. It has been acclaimed by leading authorities in these professions to be the *outstanding* non-poisonous antiseptic for all home requirements. Scientists today know that active oxygen is one of the greatest germ-killing and healing agents. Properly concentrated it purifies and greatly assists nature's own healing process. Kemozone frees *life giving oxygen.* But it *releases* its oxygen only when brought into contact with membranes or tissues, hence its unchanging power and effectiveness under any and all conditions

are unwarranted. As far as the action of oxyquinolin sulphate is known, it does not depend for its antiseptic properties on the release of free oxygen. No evidence is adduced by Kemozone, Inc., in support of the statement. In the light of our knowledge as to the chemical character of oxyquinolin sulphate, such information is indeed surprising.

The Council desires to point out that a 1:1,000 solution of chinosol has no important analgesic action. In 5 per cent powder form, such action is present.

The Council declares Kemozone solution and Kemozone tablets inadmissible to Accepted Nonofficial Dental Remedies because they are preparations of well-known drugs marketed under a nondescriptive name (Rule 8); they are advertised with unwarranted claims and misstatements (Rule 4) to the public through dentists and the germicidal claims are not supported by adequate evidence; and the marketing of oxyquinolin sulphate (chinosol) under another proprietary name, not indicative of the important chemical component, is not in the interests of the dental profession and the public (Rule 10).

EPINEPHRIN SUBSTITUTES AND REACTIONS IN LOCAL ANESTHESIA

The following special article has been prepared by Maurice L. Tainter, associate professor of pharmacology, Stanford University Medical School, at the request of the Council, which has approved the report for publication.

SAMUEL M. GORDON, *Secretary.*

One of the most disturbing features of local anesthesia is the occurrence of alarming or unpleasant reactions, especially with mixtures of anesthetics containing epinephrin. Susceptible patients may show a train of symptoms ranging in severity from apprehension, sweating, palpitation of the heart, general excitation and tremors to the more serious collapse with circulatory or respiratory failure. The fundamental cause of these reactions is not fully understood, but considerable work has been done on the pharmacologic side, and much is known of the effects of components, in mixtures of local anesthetics, on physiologic functions in animals, the results generally corroborating clinical actions. Frequently, the immediate cause is laid at the door of individual sensitivity, and this, no doubt, is important in all drug actions, but it is not the whole story. Interestingly enough, individual susceptibilities in the reactions under discussion are revealed through the individual's response to a drug,

which at once suggests that the reactions may be caused by a drug component affecting the actions of another component of the mixture.

Twenty years ago, Fröhlich and Loewi[1] showed that cocain potentiates the actions of epinephrin on the circulatory and other organs. That is to say, infiltration of cocain into tissues in amounts which by themselves do not demonstrably affect the functions of the body sensitizes the sympathetic nerves for several hours to such a degree that epinephrin evokes about double the normal or original response. The threshold to ordinarily ineffective doses of epinephrin is so lowered by cocainization that they can now cause definite and marked systemic actions. Eggleston and Hatcher[2] have shown that a similar sensitization to epinephrin is caused by procain, apothesin and other local anesthetics, provided they are given intravenously in mixtures with the epinephrin. These local anesthetics are much less efficient in this regard than cocain, since their effects are fleeting and are produced only by intravenous injection. The latter may occur accidentally during infiltration. Since epinephrin is commonly present in the local-anesthetic mixtures used in dental practice, a pharmacologic basis for reactions in patients is apparent, and certainly the potentialities are always present.

The object of the epinephrin in mixtures with local anesthetics is to constrict the blood vessels, thereby retarding absorption of the local anesthetic, localizing the action, prolonging the anesthesia and also minimizing bleeding. If it were possible to secure these adjuvant effects by a substitute local vasoconstrictor for the epinephrin, without causing or at least increasing undesirable reactions, there would be a decided advantage in the use of such an aid. The result of such an attempt has recently been reported by Lundy in THE JOURNAL,[3] when he replaced epinephrin by ephedrin, a commonly used substitute for producing actions which more or less characterize epinephrin. Lundy found that the mixture containing ephedrin was inefficient, since it did not give a dry operative field. The explanation of this failure is to be found in the recent work of Tainter[4] dealing with epinephrin substitutes. This worker has shown that cocain does not sensitize the circulatory system to ephedrin, but, on the contrary, desensitizes, and to such an extent that, after cocainization, ephedrin is completely ineffective for raising blood pressure, constricting blood vessels, accelerating the heart and so on. Other epinephrin substitutes, such as tryamin and phenylamino-ethanol, are also desensitized, or rendered ineffective, and therefore they can not be used as substitutes for epinephrin. Tainter has found that the circulatory actions of the new epinephrin-like compound, synephrin, are unaffected by cocainization, which makes it appear promising as a substitute. Unfortunately, synephrin is not so efficient as epinephrin when acting as a vasoconstrictor in infiltration of the skin and subcutaneous tissues. Nevertheless, it is being tried in dental practice, but it remains to be seen whether the new drug will be suitable.

An ideal synergist in local anesthesia should be a strong vasoconstrictor, in order to stop the circulation in the anesthetized area; should be unaltered in its action by

1. Fröhlich and Loewi: Arch. exper. Path. Pharm., 62:160, 1910.

2. Eggleston, C., and Hatcher, R. A.: J. Pharmacol. Exper. Therap., 13:433 (Aug.) 1919.

3. Lundy, J. S.: Anesthesia for Dental Operation, 17:1012 (June) 1930.

4. Tainter, M. L., and Chang, D. K.: J. Pharmacol. Exper. Therap., 30:193 (Jan.) 1927. Tainter, M. L.: J. Pharmacol. & Exper. Therap., 36:29 (May), 569 (Aug.) 1929.

the anesthetic agent; should produce little or no systemic responses in the dosage used locally, and, finally, should be chemically stable, so that solutions of it will not deteriorate on standing. Epinephrin fails in several of these particulars, although its strong vasoconstrictor action has made it the drug of choice. The substitutes tested thus far have not met these criteria sufficiently well to establish themselves over epinephrin. As yet, only a small number of the available compounds have been examined. Therefore, it may be hoped that continued research may result in the discovery of a substitute for epinephrin which will satisfy the needs of local anesthesia practice and avoid the undesirable systemic reactions now practically unavoidable in the use of epinephrin.

BUREAU OF DENTAL HEALTH EDUCATION

THE GENERAL PRACTITIONER'S RESPONSIBILITY IN THE PREVENTION OF PERIODONTOCLASIA*

By ARTHUR H. MERRITT, D.D.S., F.A.C.D., F.A.A.P., New York City

THOMAS B. HARTZELL[1] has publicly stated that "periodontoclasia is a more nearly universal ailment than any other with which the healing art is concerned." It is, he says, even more common than dental caries. One thing, at least, is certain: it is, in one form or another, one of the most common and neglected of all dental diseases. Almost no person in adult life possesses a perfectly healthy periodontium. Efforts at prevention, diagnosis and treatment of periodontal diseases constitute the one outstanding failure of dental practice—the most serious indictment which can be brought against the profession of dentistry. Many people who are regular patrons of the dentist and who are receiving excellent care in the field of restorative dentistry are almost wholly neglected so far as the health of the periodontal tissues is concerned. By some curious inconsistency, the dental profession has bestowed infinite care on the teeth themselves, repairing and restoring them with such skill as to make American dentistry the synonym for excellence throughout the civilized world, at the same time that it almost wholly neglects the health of the tissues which surround and support the teeth. The consequence is that, in too many instances, in spite of the beautifully carved inlay or anatomically perfect restoration, the teeth become involved in periodontoclasia, resulting finally in the loss of both restoration and teeth. The care of the teeth logically begins with the conservation of the tissues which maintain them in place. To neglect their care is to fail to do first things first.

The responsibility for this situation rests squarely on the shoulders of the general practitioner of dentistry. It is to the family dentist that the patient naturally turns for the solution of all his dental problems. He has a right to expect his dentist to assume full responsibility in this field, to make the examination and diagnosis, give such treatment as may be indicated and, when necessary, refer him to a specialist.

But vastly more important is his responsibility for the prevention of disease as it affects the periodontal tissues; for

*Read before the Section on Mouth Hygiene and Preventive Dentistry at the Seventy-Second Annual Session of the American Dental Association, Denver, Colo., July 23, 1930.

1. Hartzell, T. B.: Practical Things Every Dentist Should Know Regarding the Treatment of Periodontoclasia, J.A.D.A., 16:1466 (Aug.) 1929.

no matter how successful treatment may be, it can never wholly undo the destructive effects of periodontoclasia as it is represented by gingival recession, pocket formation and bone loss. Treatment may restore to health the remaining tissues, but it can do no more. The receded gingivae, the loosened and weakened teeth, the sensitive root surfaces, the increased difficulty of maintaining mouth hygiene, all bear testimony to the limitations of treatment and serve to emphasize in a striking way the far greater value of prevention.

The importance of early recognition cannot therefore be overemphasized, and since it is to the general practitioner that the patient goes in the first instance, it is the dentist in general practice who must be prepared to recognize the early signs of disease as these appear in the gingivae, and take such steps as may be necessary to prevent their progress.

In this connection, it should be remembered that the advanced and possibly hopeless case of periodontoclasia had its origin in some small and unnoticed inflammation in the gingivae, and had this condition been recognized and properly treated, that whole series of changes which led up to the destruction of the deeper periodontal tissues and the final loss of the teeth would have been prevented.

In order to prevent or control any disease, it is necessary to understand its etiology. What, then, are the essential etiologic factors in periodontoclasia? If it is clearly understood what these are, and proper measures are taken to eliminate them, the most effective step possible in the prevention or control of periodontoclasia will have been taken. Fortunately, these factors are but two in number; namely, the presence of bacteria with their toxins and ferments, and a lowered resistance to infection on the part of the periodontal tissues. There are, of course, other factors to be considered, such as a possible biologic background, diet and the purely local factors of oral sepsis, food impaction, occlusal stress, etc.; but these are important chiefly as they contribute to increasing the number and virulence of the bacterial element and to lowering cell resistance in the periodontal tissues themselves.

Chief among the causative bacteria are the streptococcus and staphylococcus. Because of their peculiar invasive property, they gain entrance to the periodontal tissues under conditions of lowered resistance by way of the gingivae, involving the pericementum and alveolar process and slowly destroying them. Noyes has called attention to those subtle histopathologic changes occurring in the pericementum and inner walls of the alveolus and referred to by Box as rarefying pericementitis fibrosa, as due to penetration of these tissues by the above-mentioned bacteria, and he has emphasized the fact that the bacterial invasion frequently occurs with little clinical evidence of disease in the periodontal tissues. These organisms are, so to speak, advance agents in the production of all those pathologic changes occurring in the periodontium and summed up in the term "periodontoclasia"; namely, gingival inflammation and recession, bone destruction, pocket formation, suppuration, loose teeth, etc. Control these and that other factor of tissue resistance, and a most effective step will have been taken in the prevention of all periodontal diseases. Indeed, all preventive measures are directed toward building up the forces of resistance and the reduction of mouth bacteria.

How is this to be done and just what measures are to be taken, and in what

sequence, to bring about the most desirable result?

The first step in the preventive program is a thorough and comprehensive dental examination. As this is often made, it consists of little more than a perfunctory examination for caries, gross deposits of salivary tartar, missing teeth, etc. Little or no attention is given to the condition of the periodontal tissues unless they are more or less obviously involved in disease as represented by marked gingival inflammation, receded gums, loose teeth, etc. The examination of every patient should begin with a careful scrutiny of the soft tissues of the mouth. The gingivae, it should be remembered, are the door through which, in most instances, disease gains entrance to the periodontal tissues. Each gingiva should therefore be carefully examined, and any departure from normality in color, form or position should be noted, the operator not forgetting that the mild and inconspicuous inflammation at some point may represent the initial clinical symptom, which, if neglected, will result in a hopeless case of periodontoclasia. The examination should also include a complete roentgenographic survey of both jaws. No dentist should ever assume the dental care of any patient or attempt to make a diagnosis without such an examination. The number of pockets that may be present and the amount of alveolar process that can be resorbed with almost no clinical evidence of either will be a matter of astonishment to any one who has not made this a routine part of his examination.

Careful inquiry should also be made regarding the patient's general health and, when necessary, he should be referred to his physician. Diet also is a matter of the utmost importance in the prevention of periodontoclasia, and foods containing vitamin C and rich in calcium should be prescribed. Dairy products, leafy vegetables and fruits, the latter preferably raw, meet both of these conditions. All factors brought out in the examination should be carefully recorded and made the basis for all subsequent treatment.

The second measure to be taken in the preventive program consists in the establishment and maintenance of a high standard of mouth hygiene. The accomplishment of this represents a dual responsibility in which the family dentist must take the lead. It is his duty to establish normal hygiene in the mouth of his patient, and having done this, to so instruct him in the principles of oral hygiene that he can, with the cooperation of the dentist, maintain that condition. The thorough cleaning of the teeth is the first step. This consists in exploring and emptying the gingival crevice of every tooth, the application to the teeth and gums of tincture of iodin of proper strength and the thorough polishing of the exposed surfaces of all the teeth. All defective contact points, all overhanging edges of fillings, all restorations of whatever nature that interfere with the maintenance of cleanliness should be corrected.

When this is done, the responsibility for maintaining mouth health is, with the cooperation of the dentist, one which belongs to the patient. The idea that he can shift this responsibility to the dentist and that, by occasional prophylactic treatments, he can maintain a healthy mouth, is a mistake, because, as has been pointed out, in the prevention of periodontoclasia, it is not only necessary to reduce to a minimum the bacterial flora of the mouth, but, what is equally important, to stimulate the periodontal circulation also. This latter aspect of the

problem can be solved only by the patient in the day-by-day care of his mouth.

In order that the patient may perform this twofold operation intelligently, it is necessary that he be carefully instructed by the dentist; and unless this is done, he probably will fail in both. He should, in the first instance, be instructed in the meaning of proper mastication; for functional use of the teeth and jaws not only stimulates circulation, but also assists in cleaning the teeth. This will need to be supplemented by the use of the toothbrush, for there can be no doubt that, under conditions of modern civilization, the toothbrush has become an important factor in the prevention of all dental ills.

A method of tooth brushing should therefore be taught that will efficiently clean the teeth and stimulate periodontal circulation without injury to either the teeth or the gums. Most dentists are agreed at present that the vibratory method is, when properly employed, the most satisfactory. In its application to the buccolingual surfaces of the teeth, the brush not only scours all accessible tooth surfaces but also exerts a stimulating influence on the gingivae themselves. After the tooth-brushing operation, the brush should next be applied directly to the gums and the same vibratory motion repeated for the purpose of stimulating the deeper periodontal circulation and hardening and making more resistant the external surfaces of the gums.

This stimulation of periodontal circulation by the proper use of the toothbrush represents the third step in the preventive program and one that is no less important than the brushing of the teeth, a fact not generally understood. When it is realized that the presence of bacteria and low tissue tone are responsible for most periodontal disease and that these can be controlled by the proper use of the toothbrush, the logic of keeping the mouth clean, and the supporting tissues of the teeth stimulated, must be apparent to all.

To make sure that the patient really learns the correct method of tooth brushing and gum stimulation, it is generally necessary that it be demonstrated in his own mouth. To explain to him how he should brush his teeth without such a demonstration will, in most instances, result in failure. Indeed, it may be necessary, in many instances, to give repeated demonstrations before the lesson is fairly learned. It is necessary, too, that the patient be furnished with toothbrushes of proper design and texture and in sufficient numbers so that he has a different brush for each daily brushing.

Dentifrices of known composition should also be prescribed and used freely. Proprietary preparations should never be recommended. A prescription designed to meet the patient's need, and that can be put up by any druggist, is the only satisfactory means of meeting this situation. Waxed silk tape should also be prescribed.

Having placed the mouth and teeth in a healthy condition and having taught the patient how to care for them, it next becomes the duty of the dentist to cooperate with the patient in his personal care by seeing him at regular intervals for prophylactic treatments and for checking up on the efficiency of his care and reinspiring him to persevere in his efforts. How often this should be done will, of course, depend on the case; but it is desirable that the patient learn to depend on himself rather than on the dentist. If he learns well the lesson of personal care, from two to four prophylactic treatments a year should suffice for any case. These should be done with the same thoroughness that characterized the first treatment; the cre-

vicular spaces should be explored and their contents removed, the gums bathed with an iodin preparation and the teeth carefully taped and polished.

Unfortunately, no matter how careful the family dentist may be, he will not be able to prevent periodontal disease among all his patients, since prevention is, in large measure, dependent on the intelligent cooperation of the patient himself, a cooperation which is not always forthcoming. For this reason, the dentist will be under the necessity, in certain instances, of rendering a service which, by its very nature, is of secondary value; namely, treatment. And yet he can, even in this field, render a highly important service if he will learn to observe the early signs of periodontal disease, and, by proper treatment, clear these up before they have progressed to the point where only the most careful and painstaking treatment will avail anything. In the early stages of gingival inflammation and pocket formation, treatment is not difficult, and the results are highly satisfactory.

Finally, because of long continued neglect on the part of some one, patient or dentist, the advanced case will all too frequently present itself for treatment. These are the cases that, generally speaking, should be referred to the specialist. The family dentist has, in these circumstances, performed his full duty when, having made the diagnosis, he recognizes his limitations and refers the patient to the periodontist. The confidence of the patient is in no way abated by such reference. On the contrary, it will be augmented.

For this reason, the general practitioner should inform himself regarding the qualifications of the periodontist in his vicinity and enlist his cooperation in the treatment of advanced cases. Through such cooperation, plus his own efforts at prevention and early treatment, he should be able to care for the periodontal needs of all his patients with credit to himself and satisfaction to them. The responsibility which rests on him is not to be taken lightly, but the task is not difficult when clearly understood, and the rewards are beyond all computation; for if he will learn the principles and practice of periodontia as they are herein briefly outlined, and will apply them in daily practice, not only will he have taken a most effective step in the prevention of periodontoclasia, but he will, at the same time, have done more than is at present possible by any other means, to bring preventive dentistry within the reach of every human being whom he serves.

580 Fifth Avenue.

DENTISTRY IN PUBLIC HEALTH*

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ANY agency or profession which has as its object the purpose of improving the physical well-being of the individual or the general welfare of the population should have a well established place in public health administration. There has been much confusion in the minds of professional men as well as laymen as to the definition of public health and when it begins and when it ends. This is due to the fact that the administration of public health must necessarily vary with time and place. It must of necessity be kept elastic, to meet the various changing conditions and growing knowledge. Because we are going through a rapid period of transition and knowledge regarding health and disease is ever widening, any rigid system will soon become out of date.

Public health aims at the promotion of individual and community health as well as the prevention of disease. It is based on the fundamental needs of human welfare; namely, food, shelter, defense and propagation. Although it may deal with the problem of the individual, its greatest aim is in the standard of health of the community, despite the fact that community health is the sum total of individual health. Good health is not entirely a medical problem. To teach the advantages of good health is within the province of every man and woman, but especially is this true of any member of the healing profession. Individual health is not sought for purely selfish reasons; it is not sought for health's sake, but as a means to useful service and satisfaction. A healthy individual finds joy and inspiration in work and service, as well as joy in play.

To live well should be a greater inspiration than to live long; yet longevity is an index to good hygiene and sanitation. The physical and mental powers, if normal, should be exercised and developed. If they operate under a handicap, this should be removed if possible, or lessened, and the individual must learn to adjust his activities within the range of his abilities.

Many of the fundamental factors in the art of hygienic living are still vague and uncertain. Only a few of the fundamental factors concerning diet and nutrition, exercise and rest, air and ventilation, work and play, water, clothing, etc., have been solved. We are still comparatively ignorant concerning heredity and mental processes. More investigations are made regarding disease than regarding health. We know more about disease than we do about health. Good health is accepted as a blessing, but we are comparatively ignorant of the common and daily things that create that good health. It is said that there is more loose talk

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concerning personal hygiene than any other subject in preventive medicine and public health. The field is still ruled largely by fads and fancies, with some information, but little real knowledge.

The fact that the dentist deals with abnormalities and diseases which are not communicable has, in my estimation, placed him in the background in public health work. Yet, the fact that he has the oral cavity as his field of work and every abnormality which he corrects is but an evidence of the outraged human mechanism reflecting distress signals in the mouth, and that more than 90 per cent of all outside infections enter the human body through the mouth or nose, should in my estimation, place him in the very front ranks, and I firmly believe that when dentists, through education in our schools, come to realize the strategic position which is theirs, and when they take advantage of this knowledge and practice preventive measures at the same time that they are practicing corrective measures, they will do more to reduce the prevalence of communicable disease than has ever been done before in the history of public health.

Without reference to the prominent place dentistry takes in highly efficient public health organizations such as we now have in several state and city health organizations, I would prefer to stress the opportunity available for every dentist in his everyday practice. Several state and city health organizations have demonstrated most successfully the value of a dental health program for children of school age. Dentistry's place in public health organizations for educational programs on public health measures and methods, mouth hygiene, personal hygiene, public health education, state and county health work, health centers, public health nursing, school inspection and examination as a means of controlling disease, school ventilation and child hygiene, prenatal care, nutrition, oral prophylaxis and toothbrush drills, now being carried on by several state, city and county health organizations, is destined to grow and enlarge until it includes every state of our Union. But this work, of course, is of interest only to especially trained workers in that field.

Our dental magazines are filled with measures and methods whereby we may help to prevent disease of the teeth and gums, but little attention is given to measures to prevent sickness or to assist in the control of the spread of communicable diseases; and yet the field in which we work is the site of 90 per cent of all infection which enters the human body. The control of many of these diseases is a public health problem, not a medical problem nor a dental problem; but the education of the public must be effected by health workers in every field of health work, with the full cooperation of every profession, if the health standard of the nation is to be materially raised. Oral prophylaxis is necessary not only to conserve the teeth and supporting structures, but also as a preventive measure against disease. Periodic dental examinations must be made not only to correct pathologic conditions of the teeth and gums but also in order that any abnormal condition of the tissues of the cheeks, tongue, throat, glands or saliva may be discovered. The dental profession often speaks of the physician referring patients to the dentist, but I wonder how many dentists are as careful to advise patients to see their physicians for assistance in the correction of pathologic conditions plainly noticeable in the mouth or throat at the time those periodical dental examinations are made. These slight signals of distress which we may notice may be the warning

signs sent out by an outraged Nature. Their recognition, and application of the necessary corrective constitutional measures, may prevent years of wasting sickness and useless suffering.

The threat of pestilence and the fear of epidemics has exerted a strong influence on public opinion to obtain legislation, appropriations and the interest of the public in public health activities. Yet dentists, dealing with a condition more prevalent than all other diseases of mankind, do not seem to be able to awaken the public to the seriousness of this disease.

The respiratory group of diseases is perhaps the most damaging of all infections of men. They are prevalent everywhere at all times, often in epidemic form, and many times as pandemics which sweep around the world, devastating millions of people. As a group, they are probably less understood than any other group of diseases; yet the causative organism, mode of transmission and curative agent are known in many of them. They are all spread through discharges from the mouth and nose, either by direct contact, by droplet infection, or, indirectly, by food, water or fomites.

Whenever the organism or virus is known, it can usually be obtained from the mucous membrane of the mouth or throat, from around the teeth or from the saliva. Some of these diseases are highly infectious long before the general symptoms appear as lesions in the mouth, often readily recognizable by the well-informed before the systemic symptoms are noted. These diseases comprise tuberculosis, measles, diphtheria, scarlet fever, influenza, whoopingcough, common colds, Vincent's infection, septic sore throat, pneumonia (all forms), cerebrospinal fevers, mumps and many others.

The medical profession has backed away from the oral cavity, leaving it as the province of the dentist, but the dentist has thought only of the welfare of the teeth. He has been so busy devising ways and means of replacing lost tooth structures that he has, in a measure, neglected the equally large field of the oral cavity itself.

In very recent years, a great commotion has been raised because the average life expectancy has been lengthened owing to the rapid increase in knowledge through research into the control of communicable diseases, and it was hoped that this extension of the average span of life could be lengthened indefinitely. Now it is realized that the degenerative diseases for individuals above 45 years of age seem to be on the increase in the same proportion or an even greater proportion than the life expectancy of the young is extended by the greater knowledge of communicable diseases.

Both communicable diseases and degenerative diseases are public health problems, and the dental profession may play a very great part in the solution of each of these problems. A working knowledge of communicable disease spread through discharge from the mouth and nose is most certainly of vital importance to the dentist. Any prophylactic measure which will tend to reduce the incidence of disease is a public health measure. Susceptibility and resistance, of which we know very little at the present time, play a very important part in the spread of disease. Oral health should be the first step in prevention of communicable disease of the young, and, if maintained through life, will tend to reduce in the same proportion the degenerative diseases caused by a foci of infection in the mouth in later years.

Healthy oral structures, firm, hard, healthy teeth and healthy tissues surrounding the teeth, denote high resistance to disease and are necessary factors in prevention. Inversely, a filthy mouth, diseased tissues, unbalanced secretions, decayed teeth, inflamed gums and an inflamed mucous membrane of the mouth denote a lowered resistance and are most certainly perfect incubators for the propagation of disease organisms.

Healthy oral tissues will also tend to reduce the number of carriers of disease, probably the only means by which certain so-called childhood diseases are kept alive.

Oral prophylaxis must be a vital factor in reducing carriers of disease. Undoubtedly, careless operating technic on the part of the dentist and oral hygienist in not properly sterilizing instruments, towels, dental handpieces, burs, cuspidors and dental furniture can be and is a source of direct infection of communicable diseases. The dentist has no way of knowing which of his patients are disease carriers, walking reservoirs of disease-producing infections, or what percentage of his cases are so-called missed cases. The virus or micro-organism itself is often contained in the saliva, which may be carelessly spread over the dental furniture, chair arms or any article in the room, and, in time, transmitted to susceptible, innocent individuals.

At all times, care should be exercised, but, during epidemics or pandemics, the greatest precautions should be taken, as many of the communicable diseases are highly contagious long before the general symptoms appear. In treating children, this fact should always be kept in mind. The transmission of disease from patient to patient, especially during times of epidemics, cannot be easily traced, but many authentic cases are on record in which infection was transmitted in this way.

The fact that many patients visit their dentists much more often than they do the family physician and that, many times, the first symptoms of general infection appear as lesions in the mouth, throat, tongue, salivary glands or cervical lymph glands, and that, very often, these symptoms appear before the individual realizes that he is sick, makes it necessary that we as dentists have a working knowledge of the characteristic action of these diseases; not in order that we should treat or prescribe for them, for that is the province of the physician, but in order that we may be able to help reduce the prevalence of these diseases and raise the standard of health in our communities.

When no mechanical cause can be found for inflammation of the soft tissues supporting the teeth, we should immediately suspect constitutional debility or bacterial invasion, or a deficient or unbalanced diet. The first symptom of pellagra is a severe gingivitis, but how foolish it would be to expect to clear up this local condition by repeated prophylaxis or local gum treatments; or, because we found Vincent's organisms, to decide that a chronic Vincent's infection was present, only to have failure reward our earnest efforts.

It is my firm belief that a considerable amount of scurvy is still with us, although it goes unnoticed, or its accompanying slight oral disturbances are attributed to other causes. Delayed healing of any kind in response to thorough and efficient treatment should be viewed with alarm. Lowered resistance to infection of any kind has an important bearing on the development of pyorrhea or inflammatory conditions of the soft tissues surrounding the teeth. Dentists who overlook this fact are likely to have a number of failures in their efforts to clear up these conditions.

Tuberculosis, in the light of our present knowledge of this disease, is not entirely a medical problem. Its control is, instead, a social and economic problem, and every individual, whether or not he belongs to a health profession, must take an active part in cleansing the world of this disease. Its control is complex and difficult, and many phases of it are not clearly understood; and because of its widespread prevalence and chronic nature, it cannot be stamped out at once. Education of the public in hygienic measures is the one sure method of reducing the incidence of this disease, as the individual alone cannot protect himself against infection without the united help of the community. Destruction of the organism, thus preventing its propagation, is the first principle of public health. As the sputum is the principal and most dangerous source of infection, it should be disinfected, burned or destroyed, so as to eliminate danger to others. As it is now considered by most authorities that at least 70 per cent of all children under 16 years of age are infected with the tubercle bacilli, it can readily be seen just what proportion of our patients may be affected to some extent by this disease.

As most of the infection in children is glandular, often so slight that it has gone unnoticed by the parents, it is frequently possible for the dentist to recognize these dangerous symptoms and, by advising the unsuspecting parents, refer such cases to the physician for therapeutic measures.

The early loss of deciduous teeth is accepted as one of the causes of defective nasal development. It is a public health duty of the dentist, wherever possible, to prevent nasal deformities when he sees that they will be caused, or the abnormality accentuated, by conditions under his control. Both the size and form of the nares are directly affected by the narrow palatal vaults that are associated with these defects. Proper nasal respiration is one of the most important foundation stones in good health. Free oxygenation is Nature's agent in combating disease.

The prevalence of tuberculosis, diphtheria, scarlet fever, cerebrospinal diseases, measles, mumps, common colds, pneumonia, septic sore throat, influenza and many other communicable diseases, with their many complications, may be markedly decreased or influenced by concerted adoption of prophylactic measures known to dentists and oral surgeons whereby the cleanliness of the oral cavity and its secretions are given more attention. Consideration of the structure and character of the teeth and their supporting tissues and the preservation of the ideal form of the dental arch, together with the effects on the development of other parts of the body and cranium, will greatly increase the nation's health as well as raise the resistance against all diseases, when given full recognition, with preventive measures strictly adhered to. The health education of our patients and of the public, with advice regarding diet and its influence on structural defects through prenatal life and childhood, is a wonderful opportunity open to dentists to serve their fellow man.

The treatment of children with a view to obtaining perfect development of the teeth and oral cavity, thereby avoiding many of the various defects which eventually lead to oral sepsis and ill health, is the easiest, cheapest and best method of preventive treatment. Oral prophylaxis should include the handling by the dentist and physician of every abnormal condition of the mouth, nose and throat which may give rise to mouth breathing, general debility, infection and disease,

and interfere with the proper development of the architecture of the body, particularly of the throat, nose, jaws and teeth. When the physicians and dentists, as well as the laity, become fully aware of the influence which defective teeth and oral sepsis have on the development and health of the average individual, oral prophylaxis will hold the important place in preventive medicine that it so richly deserves, and the results will be economy in time and expense to the patient, increased physical and mental efficiency, a greater average duration of life, lessening of the communicable diseases, better preservation of tissues in old age and fewer chronic diseases.

Before closing, I feel I would be remiss in my duty if I did not mention the care which must be given to the indigent if the dental profession is to retain its place and advance in public health work. The people are being taught the necessity of early dental care and they are fast coming to realize the serious handicap which results when this is neglected.

We are now beginning to realize our inadequate facilities for caring for the worthy and indigent poor. The medical profession has its hospitals where worthy charity can be extended, but, with the exception of insufficient school dental clinics in a few cities, the dental profession does not have methods to dispense dental treatment to the worthy poor. School dental clinics for educational purposes, examinations, prophylaxis and simple surgical and corrective measures are of great value, but they do not reach the child of preschool age nor do they have facilities or personnel for correcting irregularities, malformations and deformities of the teeth and jaws, so closely associated with poor health.

At the present time, when our nation is prosperous and many of our citizens are able to give large grants of money or endowments toward research of every kind, the dental profession is lagging far behind other professions through lack of concerted effort to interest individuals in the establishment of endowed or semi-charitable institutions such as Forsyth and Rochester dental infirmaries.

I believe that it would be possible to raise a sufficient fund in every large city throughout our country if every dentist was interested and if a committee of prominent dentists, as well as other citizens, was selected in each community for that purpose, and proper cooperation and publicity were given with that aim in view. The capital or endowment involved need not be so tremendous when it is considered that such a dispensary should be partially self-supporting and should, as other charity health organizations, expect assistance from the local community chest until such time as its endowment fund was permanent and sufficient to meet the needs of the community.

I should like to see a dentist on every state board of health, in order to coordinate dental health activities throughout each state and work in cooperation with the local city and county health agencies. I should like to see a dentist on every city health council to supervise dental health programs throughout the city schools, and, by education and organization, make it possible for dental facilities to be available for every child of preschool and school age, either at the office of the family dentist or in institutional dental clinics.

In this wonderful country of ours, which is far more fortunate than most nations in that its number of helpless and unfortunate citizens is proportionately smaller than that of any other country in the world, we still have a certain pro-

portion of the population hardly able to acquire sufficient food or clothing. To such individuals as these, dentistry in any of its phases is a luxury; and if they are informed by health workers that it is essential, there is no place in most communities where it can be obtained.

Individually, probably every dentist contributes to charity, not only by personal funds but also by giving some of his time and professional skill. But the oral health of the community is a community problem, and the individual dentists who must earn their livelihood should not be asked or expected to undertake this entire problem. The members of the medical profession do not individually undertake to treat all charity cases, but leave that to welfare organizations of the community, and every community has accepted this problem and has provided for it by endowment, taxation, subscription or the community chest.

The public interest can only be aroused or stimulated to recognize the need for a public dental dispensary by a concerted movement of the dental profession itself. Until the profession of dentistry in any community recognizes the need for such an institution, the public will assume that no need exists. Owing to the high cost of medical care, it has been said that only the moderately well-to-do, the rich and the poor are able to acquire efficient medical care. However, as long as the medical profession is able to care properly for the poor and indigent, it will not be entirely condemned for the high cost of medical care for others. It is now beginning to be said that dentistry is only available for the moderately well-to-do and the rich. Certainly, when it comes to corrective measures to overcome abnormalities and malformations that are not only potential agencies in lowering the standard of health in children, and thus entire communities, but are, as well, crippling influences and handicaps which must be carried through life, the present cost is beyond the means of a certain proportion of the public.

It is up to the dental profession in each community to take the first steps to correct this condition. It is up to the dental profession of each city to see that a dentist is placed on the city board of health. If the dental profession, which should know the community dental needs much better than any other group of citizens, does not believe such a movement is essential, most obviously all others will pass it by. Dentistry has already commanded millions of dollars in other communities. That alone should prove its need in every community.

Every child, whether he is born of rich parents or poor, should have the right to expect a heritage of health. If all other corrective measures are carried out through community effort, and dental needs are neglected, the standard of public health in the community will still be low. The school dental clinic, essential as it is, is not sufficient for the children's dental needs. The preschool child of the poor can be cared for only by institutions. Correction of abnormalities and malformation for this class of patients can be made only in dispensaries properly equipped and supervised.

Such a dispensary, properly organized, with a board of dentists of the local dental society as trustees, would not take one penny from the income of any dentist in the community unless it might be the unethical, dishonest advertiser, who, through lack of human pity and knowledge, usually causes every child who unfortunately falls into his hands to become a cripple for life.

It would, instead, increase personal

profit through proper education of the public. By removing, correcting or preventing handicaps in the young which might otherwise be so serious as to influence in a great degree their success in later life, we shall raise the standard of health in the community.

And lastly, it would be just another stepping stone to raise our profession just a little higher on the health plane.

PROPER DENTAL CARE FOR THE CHILD PATIENT*

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THE essays on children's dentistry presented before this section during the last several years have thoroughly and effectively covered the field. It appears that little might be added, but there are certain items that can bear frequent repetition. I shall attempt to touch on those phases of children's dentistry that are most puzzling to the average dentist: children as patients, abscessed deciduous teeth and roots, exposed pulps and filling materials.

CHILDREN AS PATIENTS

I have occasionally met some older practitioners who felt that they could not handle children, that all child patients were difficult to work for and that a dentist in order to be successful with children must be blessed with a supernatural power of persuasion or have at his command some form of hypnosis; that fillings could be inserted or teeth extracted only when the patient was taken unawares, that children's dentistry is unprofitable and that deciduous teeth cannot be expected to hold fillings satisfactorily. Such beliefs are entirely erroneous. Children, on the whole, make excellent patients, a fact which we have demonstrated to many practitioners in Iowa during the last few years of our state wide dental program. Many dentists have delightedly told me of their experiences and the revelations that had come to them.

The chief prerequisites to the successful handling of children are: (1) an infinite supply of patience and (2) an understanding sympathetic attitude. If we can foresee the good that is being done for the child, the normal development of the facial bones, the prevention of malocclusion, the elimination of possible focal infection, the maintenance of a higher systemic resistance to all disease, and can visualize an active robust happy youngster, it is possible to turn what might ordinarily be considered an unpleasant task into a privilege and a pleasurable duty. If the proper psychologic approaches are utilized, practically any dentist can work successfully with children.

ABSCESSED DECIDUOUS TEETH AND ROOTS

The universal question that dentists ask a public health dental worker is, "What should I do with deciduous teeth that are too badly broken down to be filled?" This question is too general to be answered without further qualification. Such a tooth could be abscessed, putrescent or have an exposed pulp or merely the roots be present. Each condi-

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tion merits a distinct treatment. Abscessed deciduous molars and roots should be dealt with in children much as the dentist would dispose of them for his adult patients. This, in most cases, means extraction; yet operators frequently recommend to parents that these diseased teeth remain in the mouths of children in order that the space may be maintained. It is not difficult to correlate the presence of abscessed teeth with certain systemic infections. Which is more desirable, a pathologic condition of the heart or mutilated facial features? In answering for your own child, it is not difficult to decide on the course of procedure. If the dentist will perform his professional duty, the child should suffer from neither the injured heart nor mutilation of the face. Space maintainers should be used whereever deciduous teeth are extracted prematurely, i. e., six months or more previous to eruption. Perhaps the only contraindication to the extraction of such teeth is the involvement of the second deciduous molar previous to the eruption of the first permanent molar, in which case the tooth may be treated even though a fistula is present. Three successive treatments with formocresol will usually clarify the canals and pulp chamber, which then may be filled with a paste of beechwood creosote and zinc oxid. It may be necessary to cauterize the fistula slightly with 95 per cent phenol or wipe out the tract with camphor and phenol in order to induce healing. After the eruption of the first permanent molar, the deciduous tooth may be extracted and space maintainers applied.

Putrescent teeth have been effectively treated by many child specialists, but these teeth can always be considered a possible source of infection. With judicious selection of cases, considering the child's health, age and family history, some of these teeth may be kept in position with safety. They assist in the normal development of the arch, jaws, facial bones, sinuses and contour and expression of the face. But we must remember that these physiologic processes are possible only when the tooth is healthy and the normal occlusion and approximal contact have been restored. To leave a broken down putrescent tooth in the mouth without any operative treatment, trusting that Nature will maintain the above mentioned functions, is a questionable procedure. Yet, this is frequently done by dentists who hold up their hands in horror at the thought of treating putrescent deciduous teeth or amputating pulps.

For clarifying putrescent teeth, formocresol or beechwood creosote may be used. The use of the latter eliminates any possibility of injury to the soft tissues, but more treatments are required. A paste of beechwood creosote and zinc oxid may be forced into the canals and pulp chamber.

When only the roots of a deciduous molar remain in position, little can be expected of them as space maintainers. Normal proximal contact is not present and, in most cases, serious loss of space will occur despite the roots, with resulting malocclusion. Then, too, roots are a source of infection to the child. In my experience, it is a rare instance that pus cannot be expressed from the tissues surrounding them. The roots should be removed and space maintainers applied. The overlay space maintainer advocated by Willett of Peoria is quite satisfactory.

EXPOSED PULPS IN DECIDUOUS TEETH

A pulp exposure in deciduous teeth offers two courses of procedure: (1) pulp amputation; (2) extraction. Pulp capping is not an alternative. I know of no operator who has successfully and con-

sistently capped pulps of deciduous teeth.

Pulp amputation, that is, the removal of the bulbous portion of the pulp, has been practiced on deciduous teeth for a sufficient number of years to prove its merit. The splendid case histories presented before this section last October by Dr. Sweet, the testimony of other workers and the life long experience of Dr. Jordan are convincing evidence of the success of this procedure. Pressure anesthesia offers the most satisfactory method of anesthesia for amputation of the pulp. At the children's clinic of the Dental College of the State University of Iowa, pulverized procain tablets dissolved in distilled water are used for this purpose. Slow, gradual pressure with a blunt-end instrument on unvulcanized rubber inserted in the cavity will promptly produce anesthesia. If sufficient time is given to this operation, the child will suffer little pain. The pulp may be amputated by means of a large, sharp sterilized round bur. Hemorrhage may be controlled by formocresol or 95 per cent phenol. These medicaments also serve to cauterize the tissue remaining in the canals; which is conducive to prompt healing. Phenol compound should be sealed in the pulp chamber for forty-eight hours previous to filling. The paste for the pulp chamber is the same as that used for putrescent teeth. At the time of its insertion, all coagulated blood should be removed from the cavity and especially from over the stumps of the pulps.

It is needless to state that the cavities should be kept free of saliva while putrescent teeth are being treated or a pulp amputation is being performed. A rubber dam need not be applied if the operator perfects himself in the manipulation of cotton rolls. With lower teeth, this may be accomplished by holding the rolls with the first two fingers, one on the buccal aspect with one roll, the other on the lingual with two rolls, and the assistance of a saliva ejector, if the patient does not object too seriously.

Numerous case histories have been reported demonstrating that normal shedding of these and properly treated putrescent teeth occurs. Some operators maintain that they will usually be shed approximately one year prematurely.

PULP EXPOSURE IN THE FIRST PERMANENT MOLAR

In her book on "Children's Dentistry," Jordan outlines a technic for amputation of the bulbous portion of pulps in first permanent molars. This procedure has been followed in the children's clinic of the Cook County Hospital for several years, with careful follow-up observations. It is that group's opinion that if a large apical foramen is present, the prognosis is excellent for the successful treatment of the tooth and that the growth of the tooth continues with an apparent normal development of the apical portion of the root.

FILLING MATERIALS

What filling materials should be used for children is a puzzle to many dentists. Manufacturers offer alluring cements and other preparations that supposedly can be inserted with success under very unfavorable conditions. These materials are thus designed with the thought that fillings in deciduous teeth are inherently temporary and relatively of little importance. In order to emphasize the need for permanent work for deciduous teeth, let us select a second deciduous molar in the mouth of a 5-year-old child. This tooth is normally shed between the tenth and twelfth years. If a proximoclusal cavity is present in such a tooth at 5 years of age, the inserted filling must last for from five to seven years, which is suffi-

cient indication that the cavity preparation should be carefully made and the filling constructed of the best materials available. This filling must be of service to the patient for possibly seven years, and no temporary measure should be employed, any more than if the filling were to be inserted in the mouth of an adult. I find that many dentists underestimate the shedding time for the deciduous molars.

Copper amalgam may be called the ideal filling material for children's dentistry. This substance has advantages and disadvantages, but the former are sufficiently outstanding to counterbalance the latter. The principal disadvantages are its color, slow setting time and tensile strength. The chief advantages are a low coefficient of expansion and contraction, germicidal action and a low coefficient of conductivity.

The low coefficient of expansion and contraction prevents the amalgam from contracting away from the margins of the cavity, it frequently remaining in cavities that have but very slight retention. The germicidal action prevents recurrence of caries, but must not be relied on to arrest active decay. The low coefficient of conductivity is an extremely valuable asset, as so many fillings inserted in deciduous teeth closely approximate the pulps. Use of an alloy with a high coefficient of conductivity, such as silver or gold, is apt to cause the death of the pulp. Copper amalgam largely overcomes this objection.

Another advantage frequently offered for copper amalgam is that it may be inserted in a wet cavity. It is to my mind very doubtful that a filling inserted in a wet cavity will be so successful as one inserted under more nearly ideal conditions. It has been my experience that the child who cannot be managed to the extent of keeping the cavity dry for the insertion of the filling is extremely rare. If the copper amalgam becomes wet, it may be dried over the flame or on a paper towel and used without danger of having the filling fail.

The setting time for copper amalgam can be greatly reduced by decreasing the quantity of the mercury. Reduction in the amount of mercury also seems to increase the strength of the alloy. One manufacturer has recently devised an excellent method for heating copper amalgam pellets. They are placed in a small glass tube and then heated over the flame; which gives a uniform expression of the mercury, prevents overheating and avoids loss of the mercury, thus assuring a proper mix of alloy. The frame of a discarded mirror also makes an excellent heating tray. The amalgam should never be heated over the open flame in a pair of pliers. Copper amalgam should be as carefully triturated as silver amalgam. When a smooth uniform mix has been secured, the excess mercury should be expressed by means of pliers and chamois skin. This produces apparently a dry substance and one seemingly unsuitable for use, but when it is manipulated in the palm of the hand, it again becomes plastic. Copper amalgam in such a state can be readily condensed into a hard dense filling that will set within three or four hours. The operator should caution the parent and the child that hard food should not be eaten during the next meal and that no chewing should be done for twenty-four hours on the side of the mouth containing the new filling.

CEMENTS

This type of filling material was, in former years, most commonly recommended for children's dentistry. Experience has taught us that cements are

largely makeshifts, giving on the whole unsatisfactory results; yet they are useful for filling cavities in teeth that will shed within a few months. Some brands of copper cements have been advertised as possessing extensive germicidal action. Bacteriologic tests indicate that they have some such action, but not to the extent supposed, the action being much less than with copper amalgam.

Some operators claim to have used germicidal silicate cements with success, especially for pits and fissures. If this material proves to be as useful as is claimed by the manufacturers, a very valuable filling material is available for children's dentistry.

CONCLUSION

I cannot refrain from quoting from that pioneer in the field of dental hygiene, Dr. Fones. In urging the profession to consider the child patient more seriously, he said:

> But most important of all, the appeal for conscientious attention to children's dentistry should certainly arouse the interest of the most indifferent. This important work is undertaken today, no doubt at a financial loss to the dentist, but at a great gain to the child; but children are not young and squirming and perhaps unprofitable for long. Tomorrow they are the leading citizens of your town. From a purely selfish standpoint there can be no greater insurance that a private practice will grow continuously over a long period of years than for the dentist to establish himself firmly in the minds and hearts of the children in his community by careful attention to their needs. The rewards of such professional service, especially to children, are hardly to be measured in terms like these, still it is frequently a form of appeal that must be used.

Mouth Hygiene

(This article is furnished THE JOURNAL by the Publication Department of the Russell Sage Foundation. It will appear later as the authoritative article on the subject in the Social Work Year Book for 1929, shortly to be published, a review of which will appear in THE JOURNAL.)

Mouth hygiene, as now understood, embraces several fields of endeavor: Instruction in the principles and practice of mouth hygiene by the dental hygienist; the teaching of mouth hygiene in public schools; the instruction of lay groups—such as Rotary or Kiwanis Clubs, and Parent-Teacher Associations—by lecture methods; and prophylactic treatment given by the dentist and hygienist in schools, industrial organizations, and private dental practice.

At least 95 per cent of the children of school age in the United States are in need of dental treatment. A community mouth health program takes into account the prospective mother, her diet and mouth hygiene during pregnancy; the preschool child, its diet and habits—such as thumb sucking, and mouth breathing—and the care of its temporary teeth; the school child, with attention to regular dental care, periodic cleansing of the teeth, methods of preserving dental health, and training in the home care of the teeth as a form of training for parenthood. The instruction of parents is also essential in order to establish the importance of mouth hygiene, and to win their support for any clinics organized to care for those otherwise unable to obtain dental treatment.

HISTORY AND PRESENT STATUS

The movement to further mouth hygiene had its inception in the days following Hunter's declaration that the teeth may be a primary source of focal infection. The conception that young women may be trained as dental hygienists is attributed to Dr. A. C. Fones, who in 1915 established the first training school for dental hygienists to prepare them for service in the public schools of Bridgeport. The mouth hygiene movement has now become world-wide and mouth hygiene itself is an accepted branch of public health. As such it is promoted by social organizations, schools, and industry.

That the movement has captured the imagination of the public is manifested by the extent and influence of dental clinics in various communities, such as those established by philanthropists in Boston and Rochester, N. Y., to care solely for children

under 16 years. There is a noticeable increase in the number of dental clinics for adults which are supported by local benefactors, or by dental societies, community chests, or fraternal groups. These serve as restorative rather than preventive agencies. The number of hospitals having dental interns is also increasing rapidly, and the sentiment of dental students is increasingly in favor of accepting institutional postgraduate training. In most state institutions it is the practice to have dental interns.

One of the most important recent advances is the inclusion of a dentist, to direct mouth hygiene activities, in the board of health or the board of education in some twenty states and in an increasing number of municipalities, and the licensing of dental hygienists to practice prophylaxis, or at least to teach mouth hygiene in about the same number of states. The state departments in these states have the teaching of mouth hygiene under their supervision and are furthering the work, as opportunity affords, in cooperation with local authorities. In some states, on the other hand, the mouth hygiene movement was originally sponsored by local groups, and from small beginnings has spread until it embraces considerable areas.

Several national agencies have as their primary purpose the propagation of mouth health principles; among these are the American Mouth Health Association, Dental Educational Council of America, and the International Dental Health Foundation for Children. Other health agencies are interested in mouth hygiene because the condition of the teeth affects the success or failure of their efforts along other lines. Such are the United States Public Health Service, American Child Health Association, National Tuberculosis Association, and the American Medical Association.

Much space has been given of late to articles on mouth hygiene in outstanding magazines and newspapers, written by well-known practitioners or groups in the dental profession and sponsored by reputable local organizations. Leading manufacturers' and producers' associations, such as the National Dairy Council, have also included mouth health in their educational publicity; and individual firms have prepared and distributed posters and charts and have prepared lectures for the use of health workers. Business concerns that preach mouth health include large food corporations, dentifrice and X-ray equipment manufacturers, and life insurance companies. These all benefit indirectly from their propaganda for mouth health and preventive dentistry. Practically everyone who reads or listens to the radio has received some information as to the necessity for mouth hygiene.

DEVELOPMENTS AND EVENTS, 1929

During the year there was a general advance in the mouth hygiene movement, particularly in the inclusion of dentists on the state boards of education and health, the more general acceptance of the dental hygienist as a dental health teacher, and a more general recognition of the value of prophylaxis in relation to the health of the school child, his training, habits, and scholarship. The most significant event of the year was the active campaign which commercial institutions carried on in accordance with the best professional ethics to popularize mouth hygiene through printed advertisement and radio broadcasting. The interest shown by the professional groups in disseminating information on this subject, particularly at their state and national meetings, was also marked. A further noticeable development was the inclusion of good motion picture films relating to mouth hygiene in the health series of a prominent educational film library, and the increasing use of such films in public schools.

During 1929 announcement was made of the building of large dental clinics for New York City, Chicago and Providence, and the Children's Fund of Michigan announced that one of its aims would be the promotion of mouth health programs. The establishment of research along purely dental lines in the leading medical schools by the Rockefeller Foundation was an encouraging indication that mouth hygiene had been accepted as a factor in the public health field. Progress was also made during the year in research relating to the prevention of dental decay by means of bacterial control and dietary measures.

CONSULT: Burkhart, H. J.: *Care of Mouth and Teeth,* 1928; "The Dental Hygienist as an Educator," in *Dental Items of Interest,* August, 1927; Owre, Alfred: "Give Your Teeth a Chance," in *Woman's Home Companion,* July, 1930; issues of *Journal of American Dental Association* (Department on Dental Health Education); and Black, A. D.: *Index to Dental Periodical Literature.*

R. S. VOORHEES, JR.

DIRECTORY OF STATE SOCIETY OFFICERS AND DATES OF MEETINGS, 1930-1931

ALABAMA

J. E. Brown, Jr., President.....Vanantwerp Bldg., Mobile
F. F. Perry, Secretary-Treasurer.....Shepherd Bldg., Montgomery
Date of next meeting: April 14-16, 1931.
Place of next meeting: Mobile.

ARIZONA

Claude M. Moore, President.....Goodrich Bldg., Phoenix
W. J. Johnson, Secretary-Treasurer.....Luhrs Tower, Phoenix
Date of next meeting:
Place of next meeting: Phoenix.

ARKANSAS

J. D. Jordan, President.....Boyle Bldg., Little Rock
I. M. Sternberg, Secretary-Treasurer.....Merchants Bk. Bldg., Fort Smith
Date of next meeting: June 2-4, 1931.
Place of next meeting: Little Rock (LaFayette Hotel).

CALIFORNIA (STATE)

John W. Leggett, President.....490 Post St., San Francisco
F. T. West, Secretary.....2180 Washington St., San Francisco
Howard Dunn, Treasurer.....450 Sutter St., San Francisco
Date of next meeting: April 8-10, 1931.
Place of next meeting: San Francisco (St. Francis Hotel).

CALIFORNIA (SOUTHERN)

E. Leslie Eames, President.....Auditorium Bldg., Los Angeles
C. M. Alderson, Secretary.....Brockman Bldg., Los Angeles
Frank G. Staley, Treasurer.....Roosevelt Bldg., Los Angeles
Date of next meeting: June 8-13, 1931.
Place of next meeting: Los Angeles.

COLORADO

I. R. Bertram, President.....Metropolitan Bldg., Denver
Joseph G. Ewers, Secretary.....Republic Bldg., Denver
F. W. Beesley, Treasurer.....Republic Bldg., Denver
Date of next meeting:
Place of next meeting:

CONNECTICUT

A. E. Cary, President.....904 Main St., Hartford
C. E. Peterson, Secretary-Treasurer.....34 Park Place, Rockville
Date of next meeting: April 28-30, 1931.
Place of next meeting: Hartford.

DELAWARE

Clyde A. Nelson, President.....Milford
J. Paul Wintrup, Secretary.....Medical Arts Bldg., Wilmington
P. A. Traynor, Treasurer.....807 Washington St., Wilmington
Date of next meeting: Jan. 14, 1931.
Place of next meeting: Wilmington.

DISTRICT OF COLUMBIA

Henry A. Swanson, President.....LaSalle Apts., Washington
W. M. Simkins, Secretary.....Woodward Bldg., Washington
Mark F. Finley, Treasurer.....1928 I St., N. W., Washington
Date of next meeting: Second and fourth Tuesdays in each month.

FLORIDA

W. J. Fitzpatrick, President.....Calumet Bldg., Miami
E. L. Thompson, Secretary-Treasurer.....Atlantic Block, Daytona Beach
Date of next meeting: Nov. 12-14, 1930.
Place of next meeting: Miami (McAllister Hotel).

GEORGIA

K. R. Armstrong, President.....Candler Bldg., Atlanta
G. A. Mitchell, Secretary.....Candler Bldg., Atlanta
B. K. Vann, Treasurer.....Candler Bldg., Atlanta
Date of next meeting: June 10-12, 1931.
Place of next meeting: Atlanta.

HAWAII

F. M. Branch, President.....Boston Bldg., Honolulu
J. A. Pekelo, Secretary.....471 S. Beretania St., Honolulu
J. K. S. Chang, Treasurer.....P. O. Box 1582, Honolulu
Date of next meeting: Second Tuesday of each month.
Place of next meeting: Honolulu (Library of Hawaii).

IDAHO

H. B. Colver, President.....Boise
R. A. Johnson, Secretary.....Nampa
T. L. Cartney, Treasurer.....Filer
Date of next meeting:
Place of next meeting: Boise.

ILLINOIS

E. L. Burroughs, President.....Edwardsville
A. B. Patterson, Secretary.....Morris Bldg., Joliet
R. H. Daniels, Treasurer.....Lehmann Bldg., Peoria
Date of next meeting: May 12-14, 1931.
Place of next meeting: Peoria.

INDIANA

F. R. Henshaw, President.....Medical Arts Bldg., Indianapolis
C. L. Byers, Secretary.....2138 N. Illinois St., Indianapolis
W. C. Hessler, Treasurer.....Ben Hur Bldg., Crawfordsville
Date of next meeting: May 18-20, 1931.
Place of next meeting: Indianapolis (Claypool Hotel).

IOWA

H. J. Altfillisch, President.....Bank & Insurance Bldg., Dubuque
John Scholten, Secretary.....Dows Bldg., Cedar Rapids
Frank Fourt, Treasurer.....Fairfield
Date of next meeting: May 5-7, 1931.
Place of next meeting: Des Moines.

KANSAS

K. A. Benson, President.....Winfield
F. A. Richmond, Secretary.....Federal Reserve Life Bldg., Kansas City
W. T. Triplett, Treasurer.....Salina
Date of next meeting: April 27-29, 1931.
Place of next meeting: Hutchinson.

KENTUCKY

Oscar Flener, President.....Hopkinsville
J. H. Fullenwider, Secretary.....Heyburn Bldg., Louisville
F. B. Hower, Treasurer.....Heyburn Bldg., Louisville
Date of next meeting: April 6-8, 1931.
Place of next meeting: Lexington.

LOUISIANA

M. F. Jarrell, President.....Alexandria
J. S. Bernhard, Secretary.....Medical Arts Bldg., Shreveport
O. J. Ory, Treasurer.....Garyville
Date of next meeting: April 20-22, 1931.
Place of next meeting: New Orleans.

MAINE

Stanley M. Gower, President.....Skowhegan
W. D. Taylor, Secretary.....Mechanic Falls
D. S. Roberts, Treasurer.....655 Congress St., Portland
Date of next meeting: June 18-20, 1931.
Place of next meeting: South Poland (Poland Spring House).

MARYLAND

Karl P. Heintz, President.....Cumberland
Norval H. McDonald, Secretary.....Medical Arts Bldg., Baltimore
Walter E. Green, Treasurer.....2958 W. North Ave., Baltimore
Date of next meeting: May 4-6, 1931.
Place of next meeting: Baltimore (Belvedere Hotel).

MASSACHUSETTS

Frank A. Delabarre, President.....520 Beacon St., Boston
Philip E. Adams, Secretary.....236 Newbury St., Boston
Joseph T. Paul, Treasurer.....419 Boylston St., Boston
Date of next meeting: May 4-7, 1931.
Place of next meeting: Boston (Hotel Statler).

MICHIGAN

E. G. Robbins, President.....Robbins Blk., Ishpeming
W. R. Davis, Secretary.....State Dept. of Health, Lansing
E. J. Chamberlin, Treasurer.....Ashton Bldg., Grand Rapids
Date of next meeting: April 27-29, 1931.
Place of next meeting: Detroit (Book-Cadillac Hotel).

MINNESOTA

Benjamin Sandy, President.....Medical Arts Bldg., Minneapolis
George D. Estes, Secretary.....Medical Arts Bldg., Minneapolis
T. D. Abernathy, Treasurer.....Rochester
Date of next meeting: March 4-6, 1931.
Place of next meeting: Minneapolis.

MISSISSIPPI

C. A. Moore, President.....Lexington
J. H. Brown, Secretary-Treasurer.....Newton
Date of next meeting:
Place of next meeting: Gulf Port.

MISSOURI

A. J. Thompson, President.....Shukert Bldg., Kansas City
C. W. Digges, Secretary.....Columbia
J. F. McLellan, Treasurer.....Moberly
Date of next meeting: May 11-14, 1931.
Place of next meeting: Kansas City.

MONTANA

A. E. Wilkie, President.....Havre
J. E. Buehler, Secretary-Treasurer.....Great Falls
Date of next meeting: April 16-18, 1931.
Place of next meeting: Helena.

NEBRASKA

E. A. Thomas, President.....Hastings
F. A. Pierson, Secretary.....Federal Trust Bldg., Lincoln
G. L. Spencer, Treasurer.....Sharp Bldg., Lincoln
Date of next meeting: May 18-21, 1931.
Place of next meeting: Omaha.

NEVADA

W. H. Cavell, President.....Carson City
P. H. Phillips, Secretary-Treasurer.....Medico-Dental Bldg., Reno
Date of next meeting: June 6, 1931.
Place of next meeting: Reno.

NEW HAMPSHIRE

C. B. Laffin, President.....Berlin
W. J. Moyles, Secretary.....1061 Elm St., Manchester
W. A. Young, Treasurer.....Concord
Date of next meeting:
Place of next meeting:

NEW JERSEY

George H. Martin, President.....921 Bergen Ave., Jersey City
F. K. Heazelton, Secretary.....223 E. Hanover St., Trenton
George H. Griffith, Treasurer.....42 W. State St., Trenton
Date of next meeting: April 15-17, 1931.
Place of next meeting: Atlantic City (Hotel Chelsea).

NEW MEXICO

C. C. Robinson, President.....Albuquerque
Fred Muller, Secretary-Treasurer.....Taos
Date of next meeting:
Place of next meeting:

NEW YORK

Alfred Walker, President.....100 West 59th St., New York City
A. P. Burkhart, Secretary.....57 E. Genesee St., Auburn
George H. Butler, Treasurer.....Skaneateles
Date of next meeting: May 12-15, 1931.
Place of next meeting: New York City (Hotel Pennsylvania).

NORTH CAROLINA

Paul E. Jones, President.....Farmville
N. P. Maddux, Secretary-Treasurer.....Asheville
Date of next meeting: May 4-6, 1931.
Place of next meeting: Winston-Salem.

NORTH DAKOTA

R. A. Ogilvie, President.....Grand Forks
W. S. Shaw, Secretary.....Fargo
L. E. Musberger, Treasurer.....Jamestown
Date of next meeting:
Place of next meeting: Fargo.

OHIO

D. P. Snyder, President.....137 E. State St., Columbus
E. C. Mills, Secretary.....255 E. Broad St., Columbus
Harry Cope, Treasurer.....327 E. State St., Columbus
Date of next meeting: Dec. 2-4, 1930.
Place of next meeting: Columbus.

OKLAHOMA

C. A. D. Beer, President.....Enid
E. E. Sanger, Secretary.....Yukon
C. B. Ball, Treasurer.....Frederick
Date of next meeting: April 21-23, 1931.
Place of next meeting: Oklahoma City.

OREGON

Alfred P. Watson, President.....Medical-Dental Bldg., Portland
F. W. Hollister, Secretary-Treasurer.....Medical-Dental Bldg., Portland
Date of next meeting:
Place of next meeting: Portland.

PENNSYLVANIA

A. C. Young, President.....121 University Place, Pittsburgh
C. W. Hagan, Secretary.....1011 Macon Ave., Swissvale
J. A. Brady, Treasurer.....2108 N. Broad St., Philadelphia
Date of next meeting: May 5-7, 1931.
Place of next meeting: Pittsburgh.

PORTO RICO

Jose Vicente, President.....Box 100, San Juan
J. R. Hernandez Gonzalez, Secretary.....Box 1361, San Juan
R. Fernandez Carballo, Treasurer.....Box 3291, Santruce
Date of next meeting: Dec. 13-14, 1930.
Place of next meeting: San Juan.

RHODE ISLAND

Frank H. Ackrill, President.....236 Westminster St., Providence
C. J. Smith, Secretary.....146 Westminster St., Providence
F. J. Canning, Treasurer.....7 High St., Pawtucket
Date of next meeting:
Place of next meeting: Providence.

SOUTH CAROLINA

F. C. Gilmore, President.....Palmetto Bldg., Columbia
N. W. Macaulay, Secretary.....Medical Bldg., Columbia
G. M. Meares, Treasurer.....1507 Main St., Columbia
Date of next meeting:
Place of next meeting: Columbia.

SOUTH DAKOTA

G. E. LeMar, President.....Rapid City
E. W. Elmen, Secretary.....Sioux Falls
J. W. King, Treasurer.....Aberdeen
Date of next meeting: May 11-12, 1931.
Place of next meeting: Huron.

TENNESSEE

C. W. Hoffer, President.....Medical Arts Bldg., Nashville
R. P. Moss, Secretary-Treasurer.....Broad St., Kingsport
Date of next meeting: April 21-24, 1931.
Place of next meeting: Nashville.

TEXAS

T. F. Coyle, President.....Orange
J. G. Fife, Secretary-Treasurer.....Medical Arts Bldg., Dallas
Date of next meeting: May 12-15, 1931.
Place of next meeting: Houston.

UTAH

Clifford Rudine, President.....Medical Arts Bldg., Salt Lake City
William Wood, Secretary-Treasurer.....Deseret Bk. Bldg., Salt Lake City
Date of next meeting:
Place of next meeting: Salt Lake City.

VERMONT

Patrick Mahoney, President.....Burlington
E. B. Jenney, Secretary.....Rutland
T. A. Norton, Treasurer.....Rutland
Date of next meeting: May 20-22, 1931.
Place of next meeting: Burlington.

VIRGINIA

R. F. Simmons, President.....Medical Arts Bldg., Norfolk
A. M. Wash, Secretary-Treasurer.....Medical Arts Bldg., Richmond
Date of next meeting: May 11-13, 1931.
Place of next meeting: Old Point Comfort.

WASHINGTON

G. A. Ellsperman, President.....Main St., Bellingham
A. W. C. Jeffery, Secretary-Treasurer.....Medical Bldg., Seattle
Date of next meeting: June 30-July 1, 1931.
Place of next meeting: Bellingham.

WEST VIRGINIA

H. H. Smallridge, President.....Charleston
J. E. Herbert, Secretary.....Martinsburg
John S. Stone, Treasurer.....Clarksburg
Date of next meeting: May 18-20, 1931.
Place of next meeting: Huntington.

WISCONSIN

G. E. Cleophas, President.....Beloit
E. E. Parkinson, Secretary.....104 King St., Madison
H. S. Huxtable, Treasurer.....Mineral Point
Date of next meeting: June 9-11, 1931.
Place of next meeting: Milwaukee.

WYOMING

Glen J. Morris, President.....Green River
E. C. Andrew, Secretary.....Citizens Bk. Bldg., Cheyenne
Peter Appel, Jr., Treasurer.....Hynds Bldg., Cheyenne
Date of next meeting:
Place of next meeting: Sheridan.

MISCELLANY

BOOK REVIEWS

Oral Diseases: A Practical Treatise Offering Diagnostic and Therapeutic Aid to the Practitioner of Medicine and Dentistry. By James L. Zemsky, D.D.S., New York City, Author of the "Outline of Oral Surgery." Attending Oral Surgeon to the Midtown Hospital, N. Y., Lecturer on Oral Surgery, Post-Graduate Courses, Allied Dental Council, Member Fédération Dentaire Internationale and Various Dental and Stomatological Societies. Illustrated with 414 engravings made from original roentgenograms and photographs; 402 pages; price, $8.00. Published by the Physicians and Surgeons Book Co., Brooklyn, N. Y.

This book is made up from articles by the author appearing in *The Dental Digest* over an extended period. The object has been to produce a book of the greatest practical value to the general practitioner and student, and to this end the author has furnished many case reports, which are always interesting. A legitimate stress has been laid on the value of the roentgen rays in diagnosis, and particularly on the manifold errors of interpretation leading to numerous mistakes in procedure. Too great emphasis cannot be placed on this important matter, to the end that less harm is done in the future than in the past. Conscientious roentgenologists are bearing down harder and harder not only on the necessity for having good films, but also on a careful interpretation. Much misleading evidence has resulted from lack of ability or carelessness in this important matter, and Dr. Zemsky's caution is none too pronounced or emphatic. The great majority of illustrations consist of reproductions of roentgenograms and are very well made. The quality of the paper in this volume lends itself to the very best illustrative presentation, and it is, therefore, a pleasure to look through it. A suggestion might be made for future editions in the matter of nomenclature. The author is discussing diseases in human teeth, and, therefore, such terms as "canine," "wisdom teeth," "premolars," etc., are out of place. They have long ago been relegated to oblivion by our better writers. The mechanical makeup of the book is excellent and, as has already been intimated, the paper and presswork are beyond all praise.

Orthodontic Laboratory Manual. By George M. Anderson, D.D.S., Professor of Orthodontia, Baltimore College of Dental Surgery, Dental School, University of Maryland. Illustrated; 56 pages; price, $2.00. Published by the C. V. Mosby Company, St. Louis.

This little volume is what its name implies—a manual. It is intended mostly for junior students in college, and it gives an outline in brief of the technical details for making the most commonly used orthodontic appliances. It is amply illustrated, and every student of average ability should be able to follow its teachings. It is a handy little treatise and fulfils the function for which it was intended very admirably.

NEWS

Salesman Victimizes Physicians: Physicians of Longmont, Colo., have reported that a salesman pretending to represent a well-known national clothing and uniform company is victimizing doctors and dentists. The man exhibits apparently satisfactory credentials in the form of printed order blanks and salesbooks. He takes orders for office coats and uniforms and accepts deposits on account, the balance supposedly to be paid direct to the national company on delivery of the uniform. The uniforms never arrive and correspondence with the firm in question has shown that the supposed salesman is an imposter.—*J. A. M. A.,* Sept. 20, 1930.

Improved Rubber Gloves: Surgeons' rubber gloves so fine in texture that they detract little from the sensitive touch so largely relied on by surgeons in the performance of operations, and strong enough to withstand severe usage, will shortly be available to the medical profession. The gloves are a product of a process of manufacturing rubber goods directly from latex. The new product excels anything so far produced in the rubber glove

line, according to surgeons who have been consulted during the development of the gloves. In addition to being of exceptional texture and having remarkable tensile strength, the almost pure latex product has age resisting qualities never before embodied in that particular line of rubber product manufacture. Deterioration even under repeated sterilization is exceptionally slow, scientists declare.

Deaths

Ambrose, George F., Eldorado, Kan.; Ohio College of Dental Surgery, Dental Department of the University of Cincinnati, 1885; died suddenly, July 22.

Bennington, Edwin K., Chicago, Ill.; Northwestern University Dental School, 1894; was drowned, October 29, when he fell from his boat in attempting to repair a casting target in Washington Park casting pond; aged 60.

Campbell, John Peyton, Cleveland, Tenn.; Vanderbilt University School of Dentistry, 1914; died recently.

Giffen, Edgar Louis, Detroit, Mich.; University of Michigan College of Dentistry, 1910; died, September 10, in a motor accident.

Hartman, Walter H., Rochester, Pa.; University of Pittsburgh, School of Dentistry, 1924; died, September 13; aged 31.

Leonard, T. A., Nashville, Tenn.; Vanderbilt University School of Dentistry, 1900; died recently.

Mabee, William E., Los Angeles, Calif.; State University of Iowa, College of Dentistry, 1890; died recently, aged 63.

Maloney, John F., Kalispell, Mont.; Chicago College of Dental Surgery, 1898; died of heart failure, May 31, while at work in his office.

Naff, William C., Knoxville, Tenn.; Vanderbilt University School of Dentistry, 1885; died, August 19; aged 79. Dr. Naff retired in 1924 because of failing health.

Soukup, Julius C., Omaha, Nebr.; Omaha Dental College, Dental Department of the University of Omaha, 1902; died recently; aged 49.

Taylor, George J., New York City; New York College of Dentistry, 1886; died recently; aged 64.

Todd, John C., Pittsburgh, Pa.; Pennsylvania College of Dental Surgery, 1897; died, September 25; aged 49.

ANNOUNCEMENTS*

CALENDAR MEETINGS

American Dental Association, Memphis, Tenn., Oct. 19-23, 1931.

American Dental Society of Europe, Paris, France, July 29-Aug. 1, 1931.

American Society of Orthodontists, St. Louis, Mo., April 21-24, 1931.

Dental Protective Association of the United States, Chicago, Ill., Dec. 15, 1930.

International Association of Dental Research, Memphis, Tenn., March 23-26, 1931.

International Dental Congress, Paris, France, Aug. 3-8, 1931.

Baltimore City Dental Society, January 30-31.

Chicago Dental Society Midwinter Clinic, February 2-5.

Central Pennsylvania Dental Society, at Johnstown, March 2-4.

Dallas Midwinter Clinic, February 16-18.

Kings County Midyear Meeting, Brooklyn, N. Y., February 25-28.

Greater New York December Meeting for Better Dentistry, December 1-5.

Southern Society of Orthodontists, Miami Beach, Fla., January 13-15.

Southwestern Society of Orthodontists, San Antonio, Texas, January 7-10.

STATE SOCIETIES

District of Columbia, at George Washington University, Washington, D. C., second and fourth Tuesdays in each month from October to June, inclusive.

December (1930)

Ohio, at Columbus (2-4).

January

Delaware, at Wilmington (14).

March

Minnesota, at Minneapolis (4-6).

April

Alabama, at Mobile (14-16).
California State, at San Francisco (8-10).
Connecticut, at Hartford (28-30).
Kansas, at Hutchinson (27-29).
Kentucky, at Lexington (6-8).
Louisiana, at New Orleans (20-22).
Michigan, at Detroit (27-29).
Montana, at Helena (16-18).
New Jersey, at Atlantic City (15-17).
Oklahoma, at Oklahoma City (21-23).
Tennessee, at Nashville (21-24).

May

Illinois, at Peoria (12-14).
Indiana, at Indianapolis (18-20).
Iowa, at Des Moines (5-7).
Maryland, at Baltimore (4-6).
Massachusetts, at Boston (4-7).
Missouri, at Kansas City (11-14).
Nebraska, at Omaha (18-21).
New York, at New York City (12-15).
North Carolina, at Winston-Salem (4-6).
Pennsylvania, at Pittsburgh (5-7).
South Dakota, at Huron (11-12).
Texas, at Houston (12-15).
Vermont, at Burlington (20-22).
Virginia, at Old Point Comfort (11-13).
West Virginia, at Huntington (18-20).

June

Arkansas, at Little Rock (2-4).
California Southern, at Los Angeles (8-13).
Georgia, at Atlanta (10-12).
Maine, at South Poland (18-20).
Nevada, at Reno (6).
Washington, at Bellingham (June 30-July 1).
Wisconsin, at Milwaukee (9-11).

MEETINGS OF STATE BOARDS OF DENTAL EXAMINERS

California, at San Francisco, December 13, Bert Boyd, Secretary, 610 South Broadway, Los Angeles.

Delaware, at Wilmington, January 21-22. W. S. P. Combs, Secretary, Middletown.

Illinois, at Chicago, February 2-3. Address Dental Division, Department of Registration, Springfield.

*Announcements must be received by the fifth day of the month in order to be published in the forthcoming issue of THE JOURNAL.

Kentucky, at Louisville, June 5-10. Robert L. Sprau, Secretary, 970 Baxter Ave., Louisville.

Minnesota, at Minneapolis, December 12. W. H. Smith, Secretary, 2337 Central Ave., Minneapolis.

New Jersey, at Trenton, December 1-6. John C. Forsyth, Secretary, 146 W. State St., Trenton.

North Dakota, at Fargo, January 13-16. Gilbert Moskau, Secretary, Grand Forks.

Pennsylvania, at Philadelphia and Pittsburgh, December 10-13. W. A. McCready, Secretary, 1115 Highland Bldg., Pittsburgh.

Rhode Island, at Providence, December 2-4. Albert L. Midgley, Secretary, 1108 Union Trust Bldg., Providence.

Texas, at Dallas, December 3. Maxwell C. Murphy, Secretary, Temple.

Wisconsin, at Milwaukee, December 15-19. S. F. Donovan, Secretary, Tomah.

CHICAGO DENTAL SOCIETY MID-WINTER CLINIC

The final session of the full denture section of the Chicago Dental Society Midwinter Clinic will devote a period to a consideration of full denture construction from the standpoint of the wearers of full dentures. Practically all papers and discussions of this subject are written by men who do not know this subject from the wearer's point of view.

What Is the Most Important Feature in Full Denture Construction?

We would have this question answered by any reader of THE JOURNAL who would care to cast his answer in with hundreds of others by mailing his reply to Dr. George Henderson, 336 North Central Ave., Chicago, Ill. These tabulated replies will form a basis for the discussion in this particular program.

ROBERT R. GILLIS, *Chairman.*
Full Denture Section.

CONNECTICUT STATE DENTAL ASSOCIATION

The sixty-seventh annual meeting of the Connecticut State Dental Association will be held at Hartford, April 28-30.

JOHN F. THOMPSON, *Chairman,*
Publicity Committee.

AMERICAN SOCIETY OF ORTHODONTISTS

The thirtieth annual meeting of the American Society of Orthodontists will be held, April 21-24, at the Jefferson Hotel, St. Louis, Missouri.

HARRY E. KELSEY, *President,*
833 Park Ave.,
Baltimore, Md.

CLAUDE R. WOOD, *Secretary,*
Medical Arts Bldg.,
Knoxville, Tenn.

KENTUCKY STATE BOARD OF DENTAL EXAMINERS

The next examination of the Kentucky State Board of Dental Examiners will be held June 5-10, at Louisville.

ROBERT L. SPRAU, *Secretary,*
970 Baxter Ave.,
Louisville.

WEST VIRGINIA STATE DENTAL SOCIETY

The next annual meeting of the West Virginia State Dental Society will be held in Huntington, May 18-20.

J. E. HERBERT, *Secretary,*
Martinsburg.

CENTRAL PENNSYLVANIA DENTAL SOCIETY

The nnual meeting of the Central Pennsylvania Dental Society will be held at the Fort Stanwix Hotel, Johnstown, March 2-4.

RALPH M. WOLFORD, *President,*
600 Johnstown Trust Bldg.,
Johnstown.

ILLINOIS BOARD OF DENTAL EXAMINERS

The Illinois Board of Dental Examiners will hold an examination for reciprocity applicants at Northwestern University Dental School, 311 E. Chicago Ave., February 2-3. Applicants who apply from states which reciprocate with Illinois, who have maintained a membership in their state, local or county dental society and who have been in continuous practice for five years in the state from which they apply are eligible to take this examination. Address all communications to the Dental Division, Department of Registration and Education, Springfield.

KANSAS STATE DENTAL ASSOCIATION

The sixtieth annual meeting of the Kansas State Dental Association will be held at Hutchinson, April 27-29. Among the essayists will be Percy R. Howe of Boston, Mass., and Sterling V. Mead, Washington, D. C. All members of the A. D. A. are cordially invited to attend.

FRED A. RICHMOND, *Secretary,*
305 Federal Reserve Life Bldg.,
Kansas City, Kan.

SOUTHWESTERN SOCIETY OF ORTHODONTISTS

The San Antonio, Texas, meeting of the Southwestern Society of Orthodontists will be held January 7-10. The first day is to be devoted to golf and some of the members are coming in advance of that date in order to take a hunting and fishing trip on the Gulf before the meeting.

CURTIS WILLIAMS, *Sec'y-Treas.,*
716 Medical Arts Bldg.,
Shreveport, La.

BALTIMORE CITY DENTAL SOCIETY

The sixth annual Midwinter Clinic of the Baltimore City Dental Society will be held on Friday and Saturday, January 30, and 31, at the Lord Baltimore Hotel. The clinicians and their subjects will be as follows:

Ira C. Brownlie, Denver, Colo., "Roentgen-Ray Interpretation"; Theodor Blum, New York City, "Oral Surgery"; F. Blaine Rhobotham, Chicago, Ill., "Children's Dentistry"; Karl W. Knapp, New York City, "A Simplified Wax Expansion Technic for Dental Castings." Members of the A. D. A. are invited to attend the clinic. The membership is strictly limited to two hundred and applications are accepted in the order they are received. The fee is $15. Checks should be made payable to Conrad L. Inman, treasurer, and mailed to Thomas J. Bland, Jr., 606 Medical Arts Bldg., chairman of the membership committee.

F. NOEL SMITH, *Chairman,*
829 Park Ave.

THE NEW JERSEY STATE DENTAL SOCIETY

The sixty-first annual session of the New Jersey State Dental Society will be held April 15-17, in the Hotel Chelsea, Atlantic City. For information concerning exhibits, address E. J. H. Schneider, director, 806 Clinton Ave., Newark, N. J. Clinical data may be secured from Eugene W. Roberts, chairman of Clinic Committee, 657 Haddon Ave., Collingswood.

GEORGE H. MARTIN, *President,*
921 Bergen Ave., Jersey City.

F. K. HEAZELTON, *Secretary,*
223 East Hanover St., Trenton.

UNIVERSITY OF BUFFALO SCHOOL OF DENTISTRY ALUMNI ASSOCIATION

The thirty-first annual meeting of the University of Buffalo, School of Dentistry, Alumni Association will be held in Buffalo at the Hotel Statler, Wednesday-Friday, February 25-27. A cordial invitation is extended to all ethical practitioners of the United States and Canada. A program of essays and clinics is being arranged.

JAMES J. AIGUIER,
Chairman of Publicity.

AMERICAN BOARD OF ORTHODONTIA

The American Board of Orthodontia announces issuance of certificates to the following, who have completed the board requirements: Ernest N. Bach, Toledo, Ohio; Charles R. Baker, Evanston, Ill.; Oscar Carrabine, New York City; Frank M. Casto, Cleveland, Ohio; Albert W. Crosby, New Haven, Conn.; Frank A. Delabarre, Boston, Mass.; William E. Flesher, Oklahoma City, Okla.; J. A. Gorman, New Orleans, La.; Henry F. Hoffman, Denver, Colo.; Harry L. Hosmer, Detroit, Mich.; Clinton C. Howard, Atlanta, Ga.; William R. Humphrey, Denver, Colo.; Bernard L. Hyams, Montreal, Canada; Harry E. Kelsey, Baltimore, Md.; B. E. Lischer, San Francisco, Calif.; John V. Mershon, Philadelphia, Pa.; Harry L. Morehouse, Spokane, Wash.; Frederic T. Murlless, Jr., Hartford, Conn.; James D. McCoy, Los Angeles, Calif.; Herbert A. Pullen, Buffalo, N. Y.; Alfred P. Rogers, Boston, Mass.; Harvey A. Stryker, Santa Ana, Calif.; Allen H. Suggett, San Francisco, Calif.; Leuman M. Waugh, New York City; B. W. Weinberger, New York City; Oliver W. White,

Detroit, Mich.; Raymond C. Willett, Peoria, Ill.; J. Lowe Young, New York City.

OREN A. OLIVER, *Secretary,*
1101 Medical Arts Bldg.,
Nashville, Tenn.

SOCIETY FOR THE ADVANCEMENT OF GENERAL ANESTHESIA IN DENTISTRY

The next meeting of the Society for the Advancement of General Anesthesia in Dentistry will be held Monday evening, December 15, at the Barbizon-Plaza Hotel, 58th St. and Sixth Ave., New York City, at 7 o'clock. The scientific session is scheduled to begin at 8 o'clock. William J. McLaughlin will read a paper on "Considerations of Technic Concerned in the Induction and Maintenance of a Short and a Prolonged General Anesthesia for Dental Surgery." Paul M. Wood will speak on "A Comparison of the Phenomena of Normal Physiologic Respiration and Anesthetic Respiration." Membership in this society is open to all ethical practitioners, and correspondence is invited. Meetings are held four times a year, on the third Monday in October, December, February and April, in New York City.

M. HILLEL FELDMAN, *President,*
LEONARD MORVAY, *Secretary,*
76 Clinton Ave.,
Newark, N. J.

JAMES T. GWATHMEY,
Honorary President.

TO THE READERS OF THE JOURNAL OF THE AMERICAN DENTAL ASSOCIATION

Hypercementosis: What is it and what is its clinical significance?

A perusal of our literature clearly indicates that the foregoing question requires further consideration, for up to the present writing there is no unanimity of opinion on the subject. Views regarding the nature of hypercementosis held by various authors are diametrically opposite. Pollia refers to it as "pathologic cementum" and Hopewell-Smith defines it as a "pathologic overgrowth of cementum." Gottlieb, Orban and Kronfeld, on the other hand, look on hypercementosis as not only a nonpathologic but also a highly beneficial condition. With a view to establishing the status of hypercementosis, an investigation has been undertaken in my laboratory by James L. Zemsky. The study of this subject will require certain clinical data in order to determine whether hypercementosis has been observed to have an effect on the body. It is held that hypercementosis is "the etiologic factor of serious nervous manifestations" (Endelman and Wagner) and that it "gives rise to reflected and diffuse pain and discomfort" (Bunting). It is also claimed that "neuralgia, functional blindness, functional deafness, chorea, epileptiform fits, cardiac neuralgia, insanity and other related conditions have been cured by the extraction of hypercementosed teeth" (Burchard and Englis, Brubaker) and "cases have been reported in which serious nervous manifestations such as chorea, epilepsy, paralysis and insanity have been traced to dental hypercementosis and have been relieved by the extraction of such teeth" (Bunting). The foregoing contention of the writers named regarding hypercementosis is not shared by a number of other investigators, nor has it been the experience of a large group of clinicians. To be of any real value, a view must be well founded; which is obviously not the case with hypercementosed teeth. It is with the hope of establishing the facts regarding this condition that attention is called to the matter, in the hope that sufficient interest in the subject will be aroused to secure the cooperation of those members of our profession who have made any observation of this condition. Following is a list of questions, the answers to which will furnish the necessary information and make it possible to establish the clinical facts on this important subject. In answering, reference to the number of the question is sufficient. Replies should be addressed to Charles F. Bödecker, Columbia University School of Dental and Oral Surgery, 630 West 168th Street, New York City.

QUESTIONNAIRE TO DETERMINE THE CLINICAL SIGNIFICANCE OF HYPERCEMENTOSED TEETH

GROUP A

1. Have you found any hypercementosed teeth in your patients suffering from serious nervous manifestations?
2. (A) Were these teeth removed or
(B) was the hypercementosed portion of the root resected?

3. (A) Was the patient's condition improved? (B) For how long?
4. Were the hypercementosed teeth or surrounding bone pathologic?
5. (A) Were the hypercementosed teeth vital?
   (B) Clinically?
   (C) Roentgenographically (root canal fillings)?

GROUP B

6. Have you found any hypercementosed teeth in your patients suffering from reflected and diffuse pain or discomfort?
7. (A) Were these teeth removed or (B) was the hypercementosed portion of the root resected?
8. (A) Was the patient's condition improved? (B) For how long?
9. Were the hypercementosed teeth or surrounding bone pathologic?
10. (A) Were the hypercementosed teeth vital?
    (B) Clinically?
    (C) Roentgenographically (root canal fillings)?
11. (A) What percentage of patients (approximately estimated) were benefited by removal of hypercementosed teeth or (B) resection of the hypercementosed portion of the root?
12. (A) If you did not make any observations of this condition, would you do so in the future and (B) would you like to receive another questionnaire at a later date?

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Antiseptic Dentifrice Perfected by Dental Scientists Destroys Oral Bacteria

DENTIFRICES, in one form or another, have been in use as mechanical cleansing agents for the teeth for over fifty years. It was not, however, until 1908, after 18 years of exhaustive research and study by an American dentist, the late Dr. N. S. Jenkins, then president of the American Dental Society of Europe, working in collaboration with Professor W. D. Miller, that the value of a dentifrice as a means of combatting the activities of oral bacteria was determined.

From 1881, when Professor Miller made his first scientific explanation of the cause of tooth decay, oral bacteria and the acids formed by the fermentation of food débris have been recognized among the causes of dental caries. In 1892, Dr. Jenkins began his experiments to develop an agent that not only would cleanse the teeth but that would destroy or check the growth of oral bacteria without harming the resistant power of the delicate mouth tissues.

In announcing the Kolynos Dental Cream formula which was the result of his investigation, before the annual meeting of the American Dental Society of Europe, Dr. Jenkins said:

"The problem of cleaning the teeth was comparatively simple; the two indispensable ingredients are precipitated chalk and a refined soap. I will not weary you by recounting the long process by which I came to the final selection of the disinfectants.

"You will observe that each of these ingredients, except chalk, has a distinct antiseptic or disinfectant value, but it was in their combination that I found disinfectant power such as I had hoped for, but until my experiments were ended, had scarcely dared to anticipate. This preparation (Kolynos) will cleanse and polish the surfaces of the teeth without the least danger of abrasion. It will overcome the defences of bacteria and destroy the germs. It will produce a condition of true cleanliness in the entire mouth."

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THE COLUMBUS DENTAL MFG. CO.
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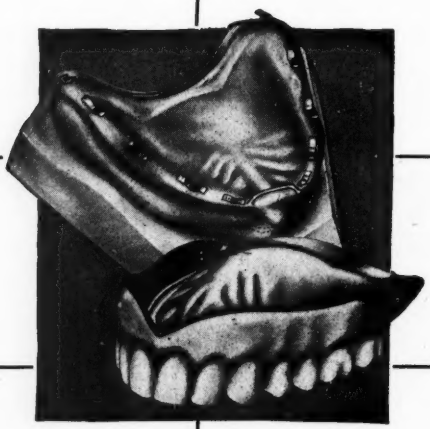

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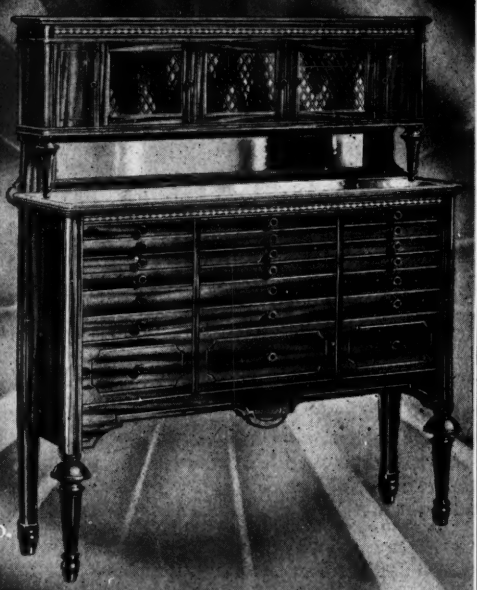

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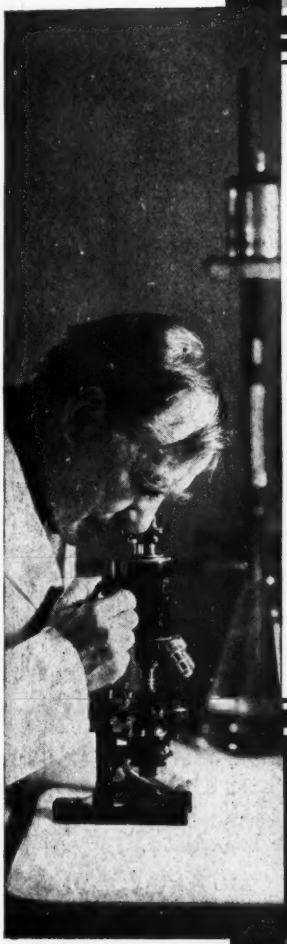

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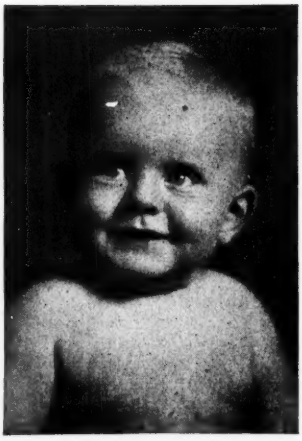

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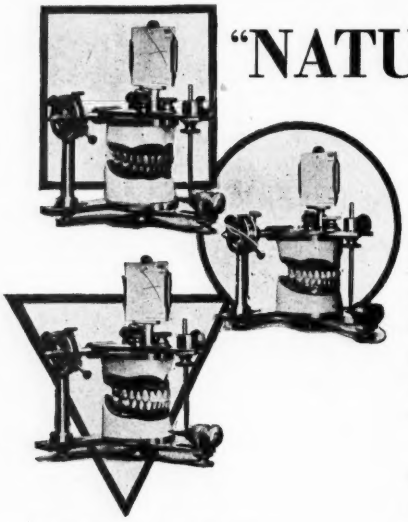

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The incisal and bite surfaces of the upper anteriors conform to the incisal and labial surfaces of the lower anteriors, thus assuring perfect contact whether the teeth be set edge to edge or with the most radical overbite.

Thin incisal edges and ridge laps widen adaptability in set-up, minimize grinding, assist mastication, are received kindly by the tongue for the re-establishment of pronunciation. The "Natural" denture is a comfortable denture.

Lifelike reproductions of the Square, Tapering and Ovoid forms, with the variations of these types, make restoration of the patient's individuality comparatively easy.

A guide for size, form and color selection is in the "Natural" Tooth booklet, which you no doubt have.

S.S.White "Natural" Porcelain Teeth

$2.60 per Combination Set of 14's
$2.34 per Combination Set of 14's in $100.00 lots

For Sale by Dealers

The S.S.White Dental Mfg. Co.
211-17 South 12th Street, Philadelphia

MAXIMUM PRODUCTION *with* MINIMUM EFFORT

The serious and productive work of dentistry is conducted at the chair, therefore every move that compels the dentist to leave the chair during an operation adds to lost time and profitless effort.

Upon this simple and obvious premise the S. S. White Equipment Unit was conceived, designed and built.

To save time and effort for the operator, all the utilities are brought within easy reach, and are under perfect control for efficient operation.

The S. S. White Equipment Unit together with the Diamond Chair permit the operator to obtain maximum production from office time, with minimum effort on his part, and surroundings inspiring and comforting to both patient and operator.

The S. S. White Equipment Unit and Diamond Chair

Your dealer will gladly demonstrate each

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By the amount and promptness of the check you receive you will know that Hoover Refining is done according to the best ethical, modern standards.

Ship us today anything containing any precious metal. If you desire product instead of cash in payment note the partial list of products we manufacture.

Remember... when you ship to Hoover for Refining, "It's the amount of the check that counts."

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Mailing containers for scrap such as is illustrated also sacks for shipping Sweeps gladly sent free on request.

We Manufacture

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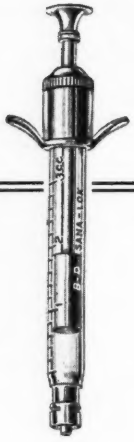

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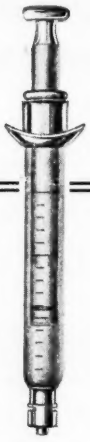

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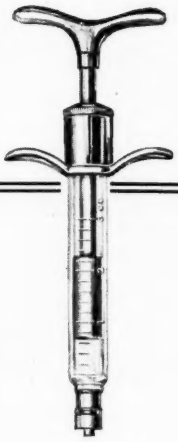

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Three Exceptional Syringes for the Dental Surgeon

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THE EVOLUTION OF A TOOTH CAVITY

FOOD PARTICLES of sugars and starches or any fermentable carbohydrates are lodged in protected areas of the teeth.

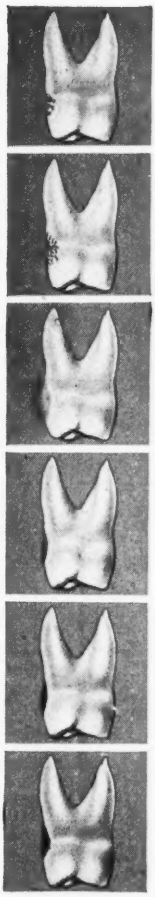
MOUTH BACTERIA work on these food particles which have not been cleaned off the teeth promptly, and manufacture lactic acid.

LACTIC ACID acts as a solvent and attacks the tooth structure, disintegrating it. It works further havoc by precipitating mucin.

MUCIN IN SALIVA is held in solution by alkalies and is precipitated and deposited on the teeth by the action of lactic acid.

BACTERIAL PLAQUES are formed by these deposits of mucin to which the bacteria cling and multiply, and under which lactic acid disintegrates the teeth.

CARIES!



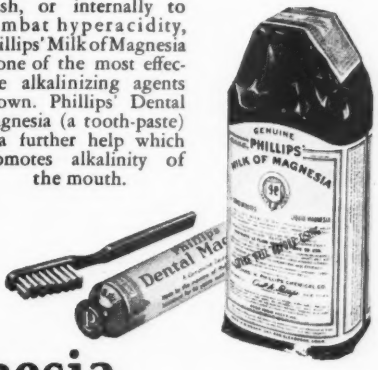
THE accompanying illustrations show the series of progressively destructive processes constantly going on in the mouth.

To combat these forces, an alkalinizing agent is indicated. The one most used by a great many dentists is Phillips' Milk of Magnesia.

They like its pronounced alkaline effect. Phillips has 3 times the acid neutralizing power of a saturated solution of sodium bicarbonate and 50 times that of lime water.

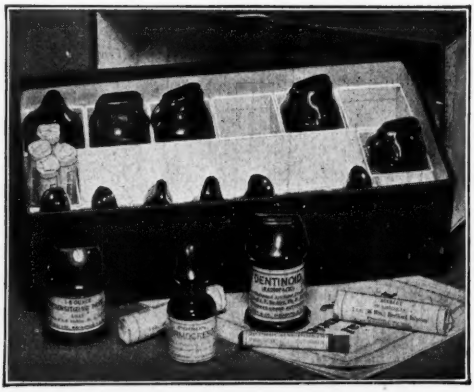
The qualities which make Phillips' Milk of Magnesia the outstanding antacid for dental use are its great surface contact because of perfect colloidal suspension, its adhesive qualities prolonging its effectiveness, and its soothing and non-abrasive properties.

Used locally as a mouth wash, or internally to combat hyperacidity, Phillips' Milk of Magnesia is one of the most effective alkalinizing agents known. Phillips' Dental Magnesia (a tooth-paste) is a further help which promotes alkalinity of the mouth.



PHILLIPS' Milk of Magnesia

Prepared only by The Chas. H. Phillips Chemical Co., New York, N. Y.



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FORMULAS OF J. P. BUCKLEY, Ph. G., D. D. S.

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The young practitioner, with this set, has nearly every needed therapeutic agent, all of the finest quality.

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ACID PHENOLSULPHONIC, Lilly. Caustic, astringent, and antiseptic.

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DEVITALIZING FIBER, Lilly For destruction of dental pulp.

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A pamphlet by Dr. Buckley, giving information on preparations, is included in each set.

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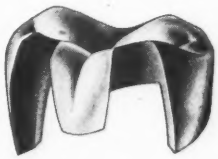

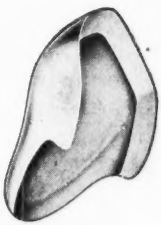

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When Tinker Casting Golds were first offered to the profession they were accorded an enthusiastic reception. Since then, year after year, they have steadily grown in popularity.

Tinker Golds are known for their dependability. Rigid shop control and U. S. Bureau of Standard's test methods insure uniformity of their physical properties. We invite you to send for our chart so that you can examine for yourself the test records of Tinker Golds.

Tinker Castings have a most pleasing color and the finest of margins are accurately reproduced. Select a gold for your next case from the list shown at the left. A trial will convince you that Tinker Golds meet the most exacting requirements. *Order thru your dealer*

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Dentists observe oral manifestations of bowel stasis. Office workers—eight hours or more at a desk—a short recess for a grab-a-bite lunch—little or no exercise, not even a brisk walk. Stasis is frequent.

Petrolagar aids these patients when taken with a rational regimen of diet and exercise. It helps them to avoid cathartics.

Petrolagar, a palatable emulsion of 65% (by volume) pure mineral oil emulsified with agar-agar, has many advantages over plain mineral oil. It mixes easily with bowel content, supplying unabsorbable moisture with less tendency to leakage. It does not upset digestion.

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Gentlemen:—Send me copy of "HABIT TIME" (of bowel movement) and specimens of Petrolagar.

Dr.....

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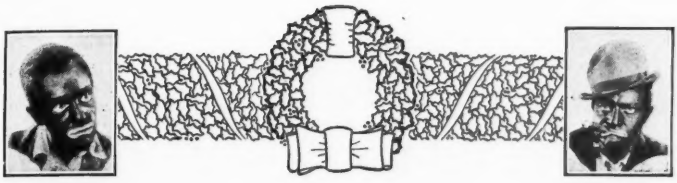

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A Merry Christmas and a Prosperous New Year

ACRIVIOLET

possesses two qualities essential for treating Vincent's Infection

1. Superior penetrative properties
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Wherever Acriviolet has been used in the treatment of Vincent's Infection, periodontists have found one of its unusual qualities to be its high degree of penetration. This special property helps carry bactericidal action into the tissue, thus attacking the spirochete usually deeply hidden.

In recent clinical tests of Acriviolet, it proved effective in more than 200 cases of Vincent's Infection.

Acriviolet is a combination of an acridine dyestuff and a triphenyl methane dyestuff. For the convenience of the dental profession, Acriviolet is packed in one ounce vials of a one per cent aqueous solution. Sample and literature on request.

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Complete the Radiographic Examination

THE extra-oral (lateral jaw) radiograph has a distinct place in radiodontia—it is a complement of the various intra-oral examinations.

In cases of impacted third molars, cysts, foreign bodies, trismus, and traumatic injuries, this examination gives additional necessary information and is an essential part of the case record.

It often reveals conditions located outside the field of the intra-oral radiographs, which would have a distinct effect on the plan of correct procedure and the success of operative results.

For intra-oral exposures you need the inherent *uniformity* and *exposure latitude* characteristic of Radia-Tized Dental X-ray Film. These same qualities, also essential in extra-oral work, may be had in Eastman Dupli-Tized X-ray Film, *the accepted radiographic recording medium the world over.*

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Physical Properties of Jelenko No. 7.

	Quenched	Tempered
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Much Stronger
More Resilient
More Flexible

HENCE thinner and lighter dentures, clasps and bars can be made. And Jelenko No. 7 is highly resistant to discoloration.

Gold Color
Per Dwt. . .$1.50

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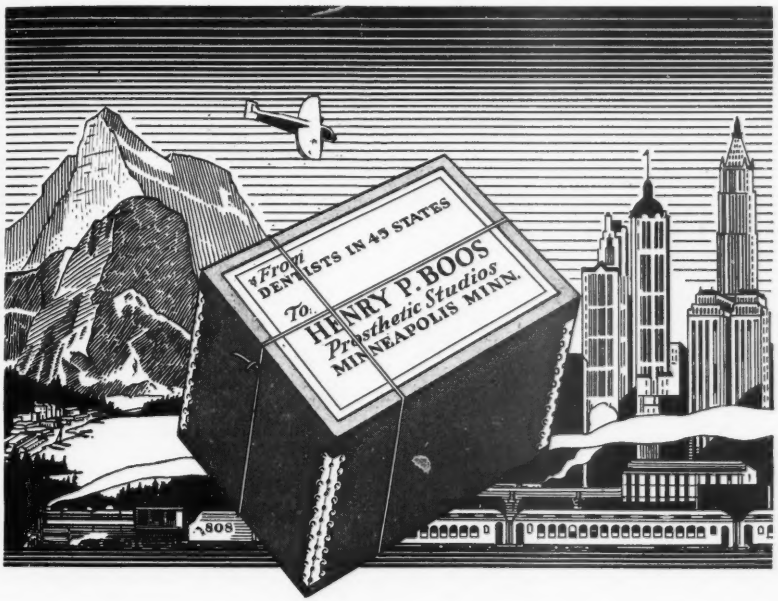

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The remarkable speed at which our fast mail trains and aeroplanes travel to-day has indeed shortened distances. Dentists in 45 states and several foreign countries find it both practical and economical to depend upon us for service and prosthetic construction at low cost.

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We know that you are always on the alert to suggest something that will prove helpful to your patients. We will be glad to send you testing samples to distribute among your patients, should you so desire. This is in addition to the full-size can for your own personal trial.

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TRY RED...
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You wouldn't think of having a RED Porcelain Jacket Crown, — but a case that is perceptibly off is just as bad a match.

In porcelain, naturalness is one of the primary considerations.

The perfect porcelain restoration is the result of experienced, specialized knowledge such as is enjoyed by the staffs of the six Lochhead Laboratories. Here porcelain carving and fusing is an art which we have practised for more than twenty years, creating beautiful restorations that are a duplicate of the natural tooth contour and color.

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THERE IS SOMETHING BIG BEHIND THE SUCCESS OF *Pycopé*

When a dentifrice, a tooth powder in an area of pastes, in the short span of 5 years, is found in every state, in the offices and homes of important dentists in all sections, then that product must have some inherent value. No dentifrice could have endured this acceptance unless it provided continued satisfaction.

Pycope' Tooth Powder aids in cleaning the teeth thoroughly. When used with the Pycope' Brush it provides a complete and effective program for the home care of the teeth and gums.

The only reason why Pycope' Products enjoy this enthusiastic acceptance, is that they give an added measure of service, easily recognized by their effectiveness in promoting and maintaining healthy conditions in the oral cavity.

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PYCOPE' PRODUCTS - THE PREFERENCE OF THOSE WHO USE THE BEST

Now Available

KERR
PRECISION INVESTMENT

A NEW EXPANDING INVESTMENT

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Which with a prescribed simple technique will enable ANYONE to make SUPERIOR INLAYS, both in ADAPTATION and SURFACE.

The Outfit Consists of:

Kerr Precision Investment	Kerr Blue Inlay Wax
Kerr Thermostatic Water Heater	Kerr Mechanical Mixer
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Kerr Painting Brushes	Kerr Dental Lubricant
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PRICE ONLY FIFTY DOLLARS

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Gentlemen: Send me free booklet, "The Precision Inlay."

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FOR SALE AT ALL LEADING DENTAL DEPOTS

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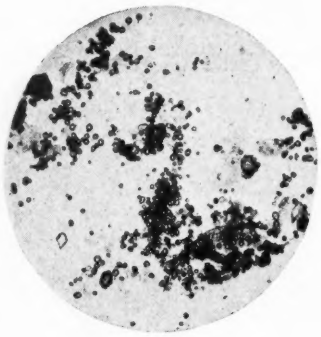

Fig. 1

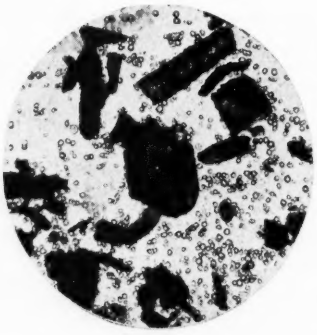

Fig. 2

In both these microphotos the magnification is the same. Both are droplets of saliva—only in Fig. 1 the sample was taken after the subject had chewed 3 Aspergum (Dillard) tablets while Fig. 2 is the result of gargling with 3 ordinary Aspirin tablets in a quarter glass of water. There you see comparatively large and coarse crystalline formation.

The much finer suspension in the Aspergum droplet shows you why:

1—Aspergum (Dillard) is preferable in mouth and throat work, because while it is being chewed it gives the oral and laryngeal tissues a continuous aspirin bath.

2—The analgesic and inhibitory action of Aspirin in Aspergum (Dillard) is therefore pronounced, probably because of better absorption. Smaller doses are sufficient when you prescribe Aspergum.

Prescribe ASPERGUM (Dillard), 1-2 tablets to be chewed as required. Each tablet contains 3.5 grs. of the finest Aspirin. For Sedation, After Extractions, in Painful Condition of the Gingivae or Larynx and particularly after Tonsillectomies—for the aspirin effect, to keep the mouth and throat moist and protected and to keep the muscles of the throat and tongue supple.

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Dental Disorders Attributed to Vitamin C Deficiency

STRONG SUPPORT for the theory that vitamin C is an important factor in the prevention and arrest of many dental disorders is reported in "The Journal of the American Dental Association".*

Augmented experiments have resulted in:

First—A report on 191 cases, establishing the relationship between dietary deficiencies and gingival irritation, pyorrhea and dental caries—with tables summarizing the changes noted in 104 cases.

Second—A finding that the daily ingestion of two full-sized (8 oz.) glasses of orange juice with the juice of half a lemon in each provided ample antiscorbutic to improve the gum conditions due to dietary unbalance in every case observed.

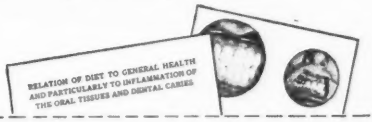
(Orange-lemon juice was used "because it is, so far as we now know, the most concentrated source of vitamin C, and it seldom leads to physical disturbances".)

Third—Actual color photographs illustrating various types of gingival tissue attributable to dietary deficiencies.

Fourth—A noted improvement in the *general health* of those who followed the dietary.

Reprints Available

These recent advances in dental knowledge have naturally interested us, as growers of California oranges and lemons. We have obtained a limited number of reprints of the article and color plates as they appeared in "The Journal of the American Dental Association". Members of the dental and medical professions may obtain copies, gratis, by mailing the coupon below.



Dietetic Research Department, California Fruit Growers Exchange,
Div. 312-M, Box 530, Station C, Los Angeles, California.

Please send me without cost or obligation your reprint of:

* "The Relation of Diet to General Health and Particularly to the Inflammation of the Oral Tissues and Dental Caries". Milton Theo. Hanke in collaboration with the Chicago Dental Research Club, Otho S. A. Sprague Memorial Institute and Department of Pathology, University of Chicago. The Journal of the American Dental Association. Vol. 17, No. 6, pp. 957-967.

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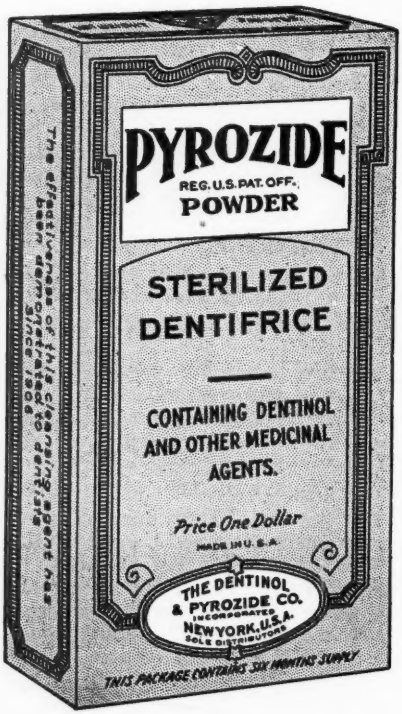
In the Home, Science and Skill Play Three Parts in the Drama of Oral Hygiene



(1) the correct method of brushing the teeth and the gums.

(2) the best type of brush for each individual mouth.

(3) the medium used on the brush.

The direction of this drama is in the hands of the dentist. Its execution is in the hands of the patient.

(1) NOT SO EASY. Demonstrations by the dentist are necessary.

(2) FAIRLY EASY. Age, size of mouth and condition of teeth and gums are factors.

(3) VERY EASY, IF PYROZIDE POWDER (medicated dentifrice) is used two or more times daily for keeping the teeth clean and the gums hard.

GUM-GRIPPED TEETH GIVE LONG SERVICE

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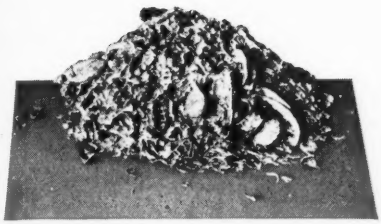

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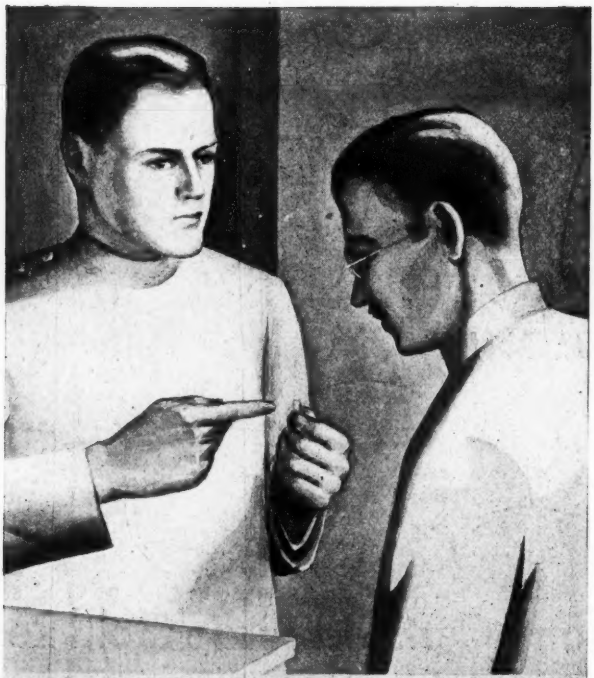

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*Peck, Willis S., M.D., and Luck, Bernard E., D.D.S.: Application of Ultraviolet Ray in Postoperative Surgery. Dental Cosmos, Vol. LXXII, Oct., 1930.

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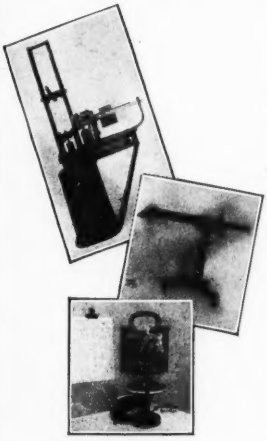

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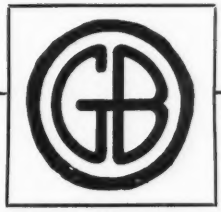

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4	4	4
5 Gadsden, Ala.	5 Jackson, Miss.	5 Logan, Utah
6 Rome, Ga.	6 Vicksburg, Miss.	6 Salt Lake City, Utah
7 Atlanta, Ga.	7 Alexandria, La.	7 Provo, Utah
10 Athens, Ga.	10 Shreveport, La.	10 Casper, Wyo.
11	11	11
21 Greenville, S. C.	12 Monroe, La.	12 Cheyenne, Wyo.
13 Spartansburg, S. C.	13 Greenville, Miss.	13
14 Charlotte, N. C.	14 Greenwood, Miss.	14 Scottsbluff, Nebr.
17 Asheville, N. C.	17 Clarksdale, Miss.	17 North Platte, Nebr.
18 Knoxville, Tenn.	18 Memphis, Tenn.	18 Grand Island, Nebr.
19 Johnson City, Tenn.	19 Pine Bluff, Ark.	19
20 Bristol, Tenn.	20 Little Rock, Ark.	20 Denver, Colo.
21 Bluefield, W. Va.	21 Jonesboro, Ark.	21 Denver, Colo.
24 Roanoke, Va.	24 Jackson, Tenn.	24 Colorado Springs, Colo.
25	25 Dyersburg, Tenn.	25 Pueblo, Colo.
26 Beckley, W. Va.	26 Paris, Tenn.	26 Santa Fe, N. Mex.
27	27	27
28 Huntington, W. Va.	28 Florence, Ala.	28 Albuquerque, N. Mex.
Dec.	Dec.	Dec.
1 Charleston, W. Va.	1 Huntsville, Ala.	1 Amarillo, Tex.
2 Parkersburg, W. Va.	2 Chattanooga, Tenn.	2
3 Clarksburg, W. Va.	3 Murfreesboro, Tenn.	3 Lubbock, Tex.
4 Morgantown, W. Va.	4 Nashville, Tenn.	4 Abilene, Tex.
5 Uniontown, Pa.	5 Columbia, Tenn.	5 Sweetwater, Tex.
8 Cumberland, Md.	8 Paducah, Ky.	8 El Paso, Tex.
9 Hagerstown, Md.	9 Owensboro, Ky.	9 Tucson, Ariz.
10 Frederick, Md.	10 Louisville, Ky.	10 Phoenix, Ariz.
11 York, Pa.	11 Lexington, Ky.	11
12 Lancaster, Pa.	12 Cincinnati, Ohio	12 Denver, Colo.
15 Allentown, Pa.	15 Richmond, Ind.	15 Omaha, Nebr.
16 Passaic, N. J. (Passaic Dental Club)	16 Lafayette, Ind.	16 Des Moines, Ia.
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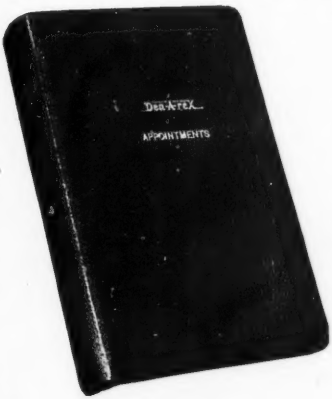

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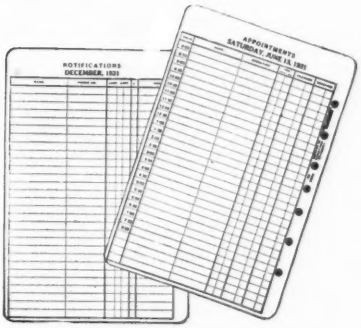

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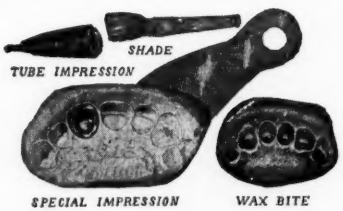

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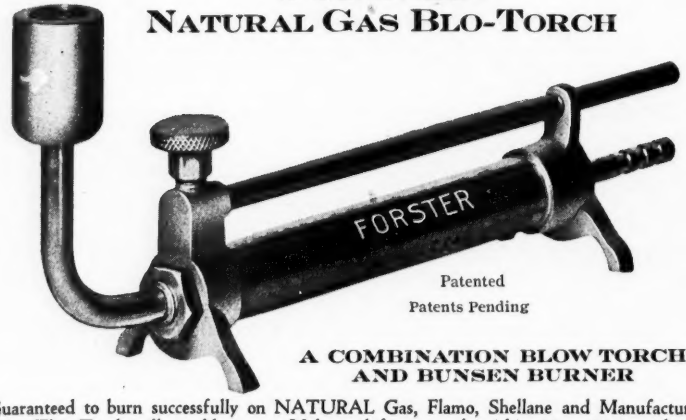

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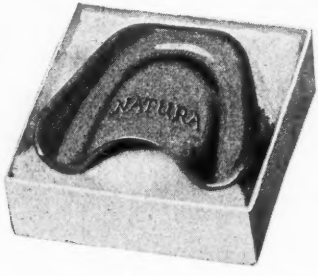

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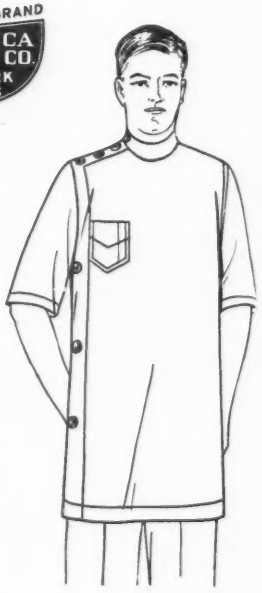

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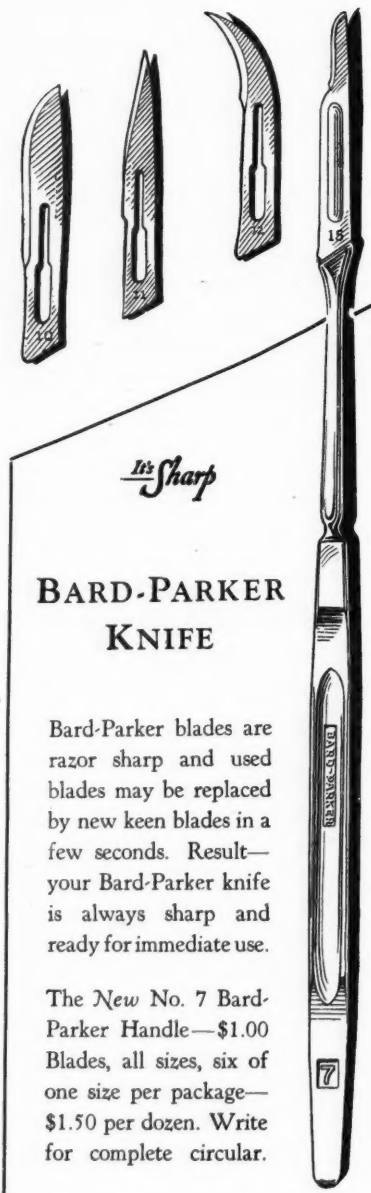

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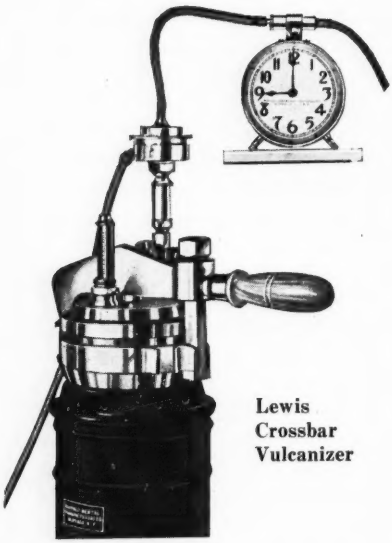

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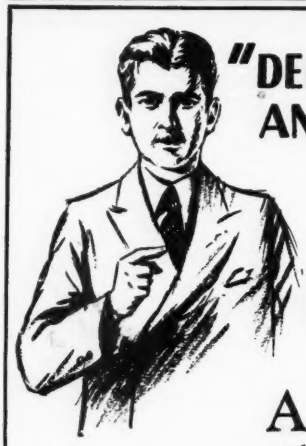

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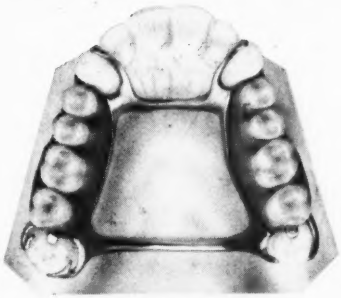

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